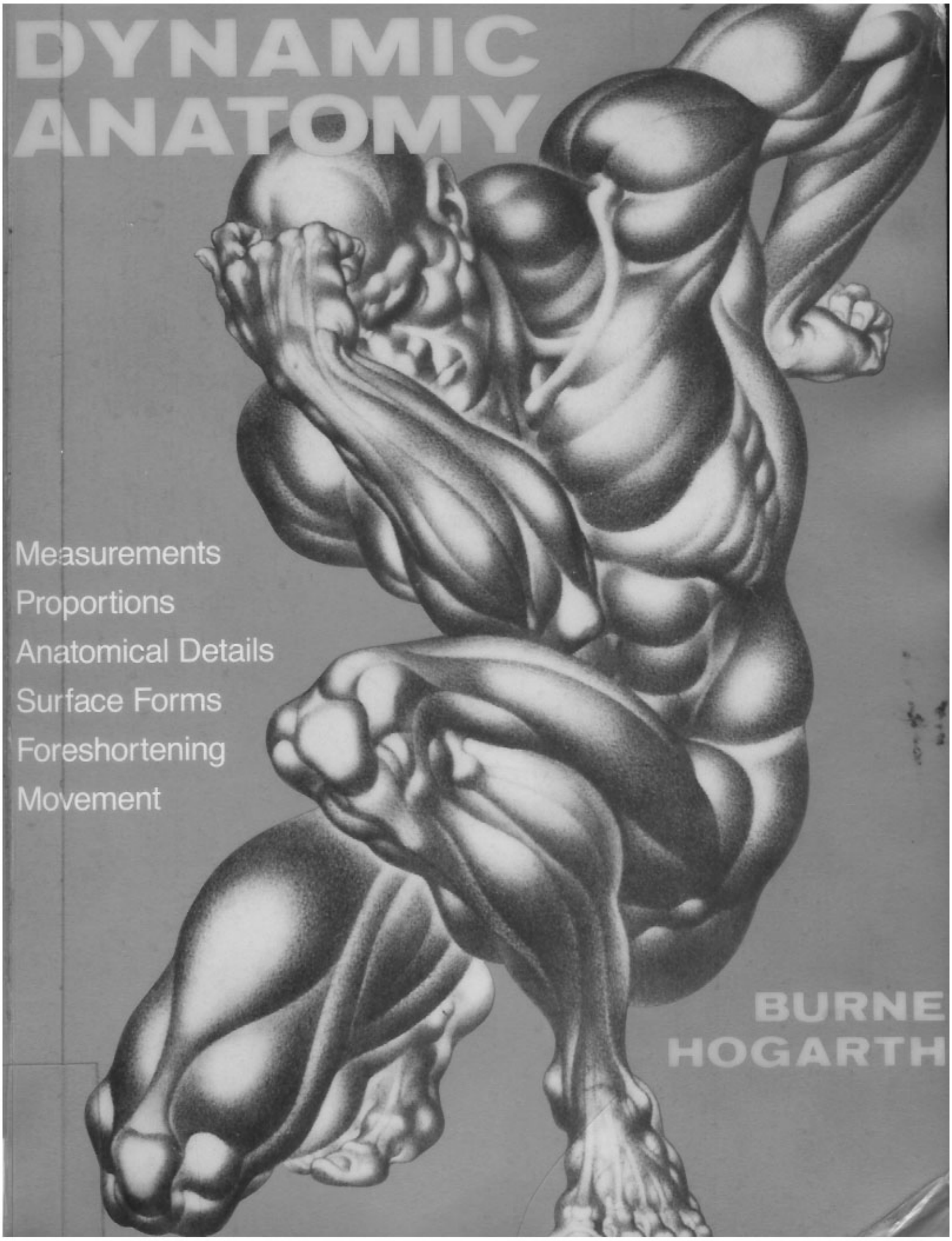
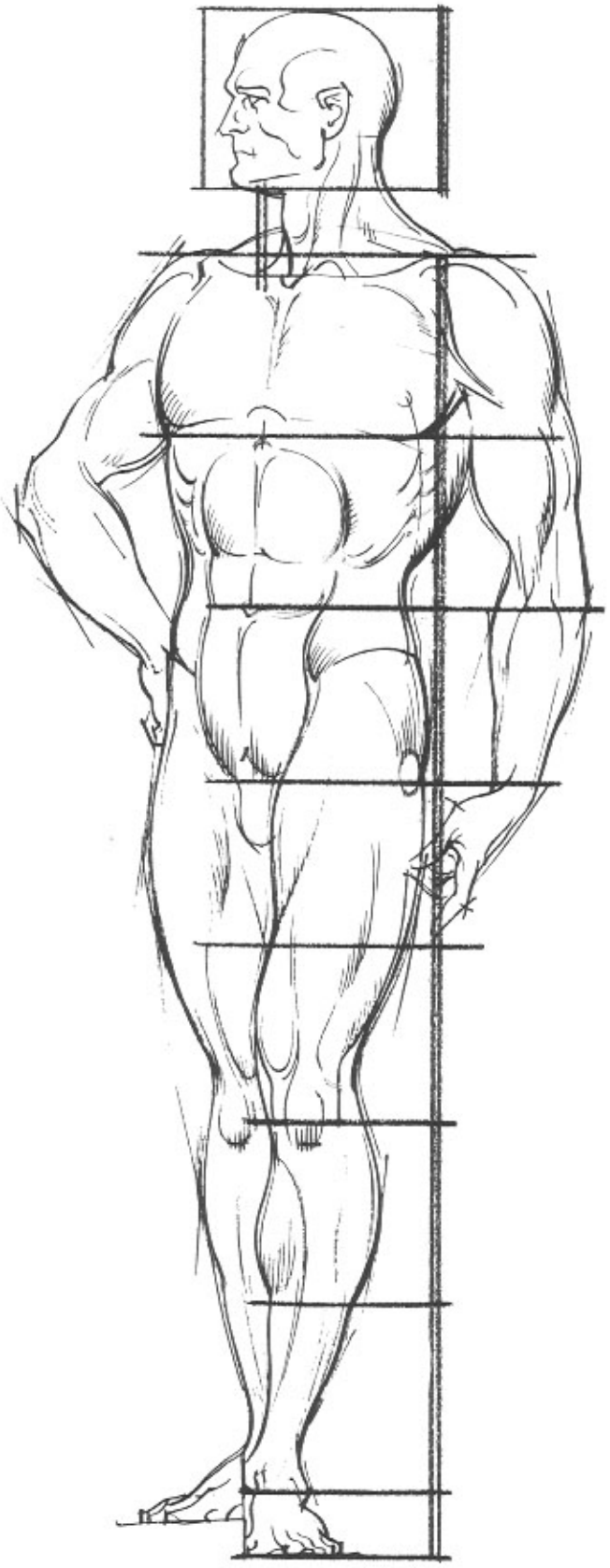
DYNAMIC ANATOMY



Measurements
Proportions
Anatomical Details
Surface Forms
Foreshortening
Movement

BURNE HOGARTH



General Proportions and Measurements of the Figure

The figure advanced here departs from the traditional length of seven and one-half heads, and is established at *eight and three-quarter heads* for the total figure length. Using the head as a unit of measurement to determine its proportions, the divisions are as follows:

1. *The Front Torso:* Three heads long, from a line drawn across the shoulders to the pubic arch, it divides (a) across the base line of the pectorals; (b) across the line of the umbilicus or navel; (c) across the line of the pubic arch.

2. *The Back Torso:* Three and a half heads long, from a line drawn across the shoulders to the base of the buttocks, it divides (a) across the base line of the shoulder blades; (b) across a line drawn through the center of the externus oblique muscles (the line of the navel in front); (c) across the line of the coccyx bone at the base of the spine (the line of the pubic arch in front); (d) across the line of the base of the buttocks.

3. *The Neck:* One-half head long in the erect position, from the point of the chin to the pit of the neck.

4. *The Arm:* Two and three-quarter heads long, from the collar bone attachment to the wrist, it divides at the elbow across the line of the umbilicus. The wrist lies on the position of the great trochanter, across the line of the pubic arch in front and the coccyx bone in the rear. The hand length adds three-quarters of a head to the arm; thus, the total length of the arms is three and a half heads long.

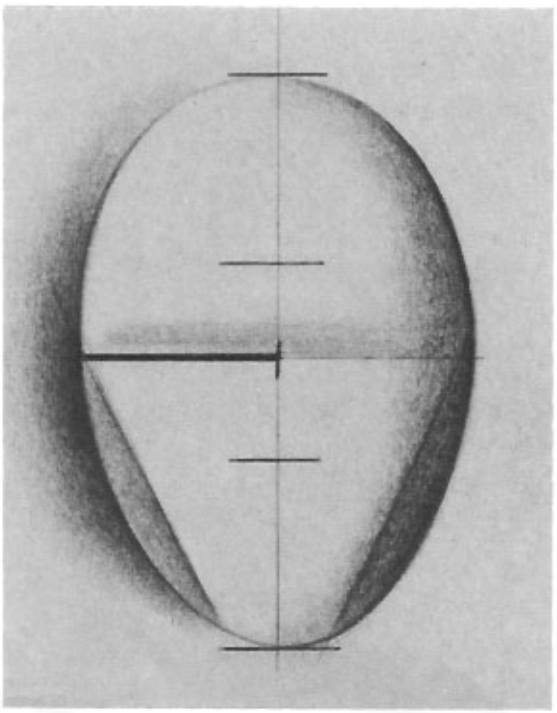
5. *The Leg:* Four heads long, from the great trochanter to the high inner ankle bone, it divides mid-point at the knee. The foot adds one-fourth head to the length; thus, the total length of the leg is four and a quarter heads long.

6. *The Hand:* Three-quarters of a head in length, or the distance from the point of the chin to the hairline; the width is one-quarter of a head wide, or the distance from the base of the nose to the point of the chin.

7. *The Foot:* The foot length is equal to the length of the forearm, or one and a third heads long; the width at the front of the foot is one-half head wide.

The finer details of measurement in the body are developed in the chapter on the Details of Anatomy and are integrated with the specific descriptions of each of the figure sections.

The basic shapes of the head. The cranial mass and the cylinder of the face.



Proportions of the head. Front view.

CHAPTER V

Masses, Measurements, and Interrelationship of Forms

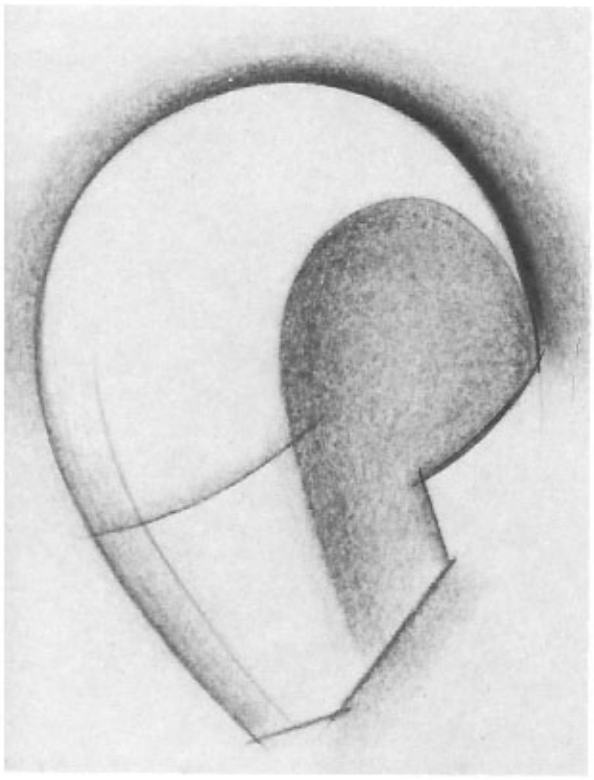
DETAILS OF ANATOMY

THE HEAD

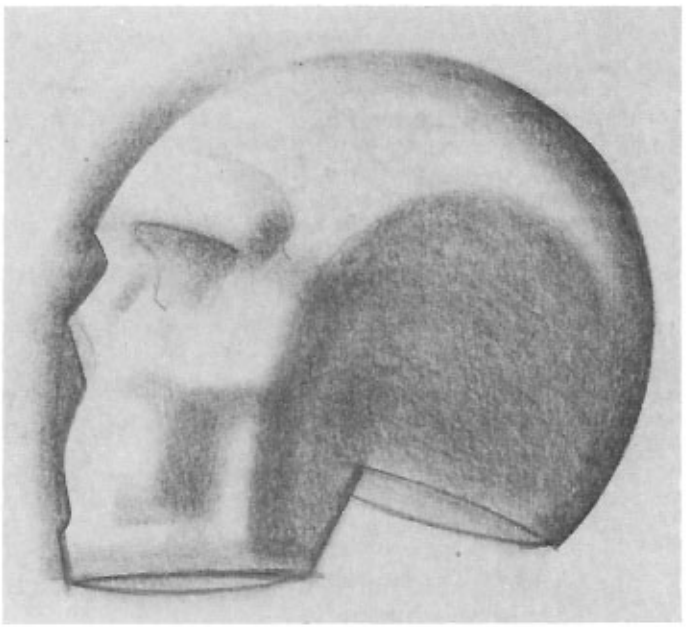
1. THE GREAT MASSES. The head consists of two major masses: the cranial mass or ball of the head and the tapered cylinder of the face. Each has a strongly-developed form at its base. The ball of the head ends in a curved ridge of bone just over the eyes — the frontal ridge or visor of the brow. The tapered cylinder of the face ends in the curved ridge of the lower mandible, the horseshoe of the jaw.

Measurements: Seen side view, the cranial mass ends at the bridge of the nose under the visor of the brow, halfway down the length of the head, from the top of the crown to the base of the chin. To the rear, the occipital bulge on the head ends lower, on a line midway between brow and chin, drawn across the skull.

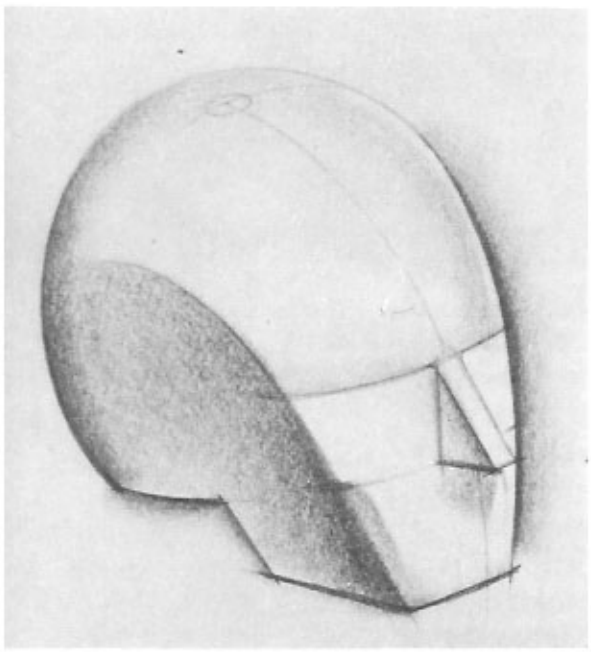
Proportions: From the front, the head is ovoid in shape. From the side, two such egg shapes superimpose one over the other. Seen front view, the width of the head is two-thirds the length; dividing the head lengthwise in equal halves, from crown to chin, will produce two parts of the width of head. One of these parts spaced three times in the length of the head will achieve the proportion of the egg mass, a ratio of 2:3 — two parts width, three parts length. From the side view, using the superimposed egg shapes, one upright, the other on its side joined at the top, the head consists of three triangular equal parts: jaw hinge to middle of the crown, jaw hinge to bridge of the nose.



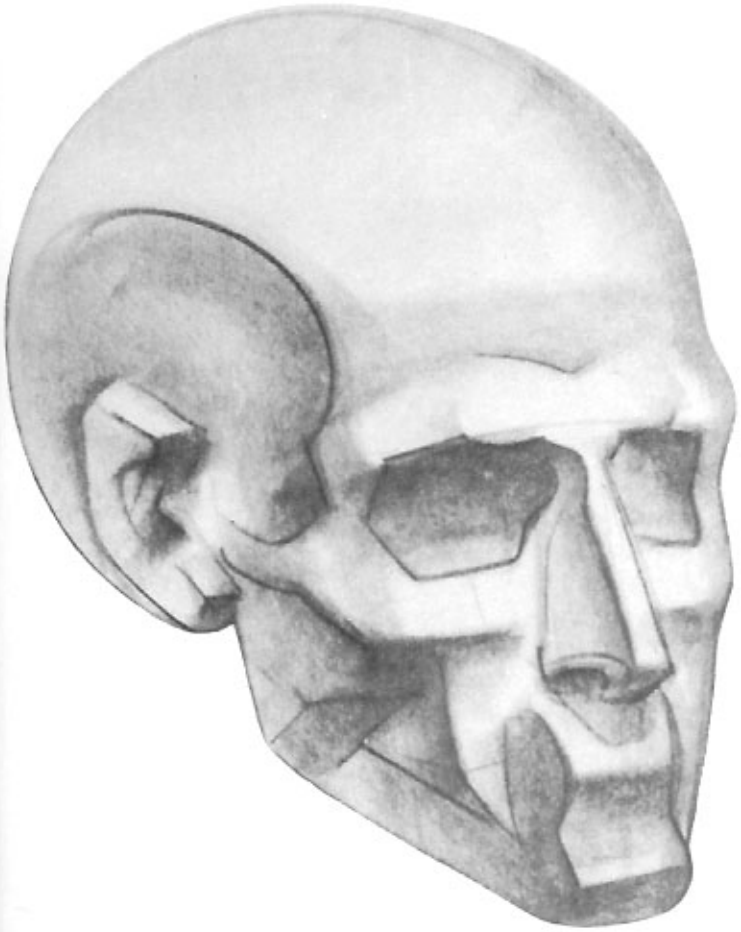
The great masses. Down view.



Skull structure of the head. Side view. The facial area is one-third the entire head mass.



The masses in development. Three-quarter view.

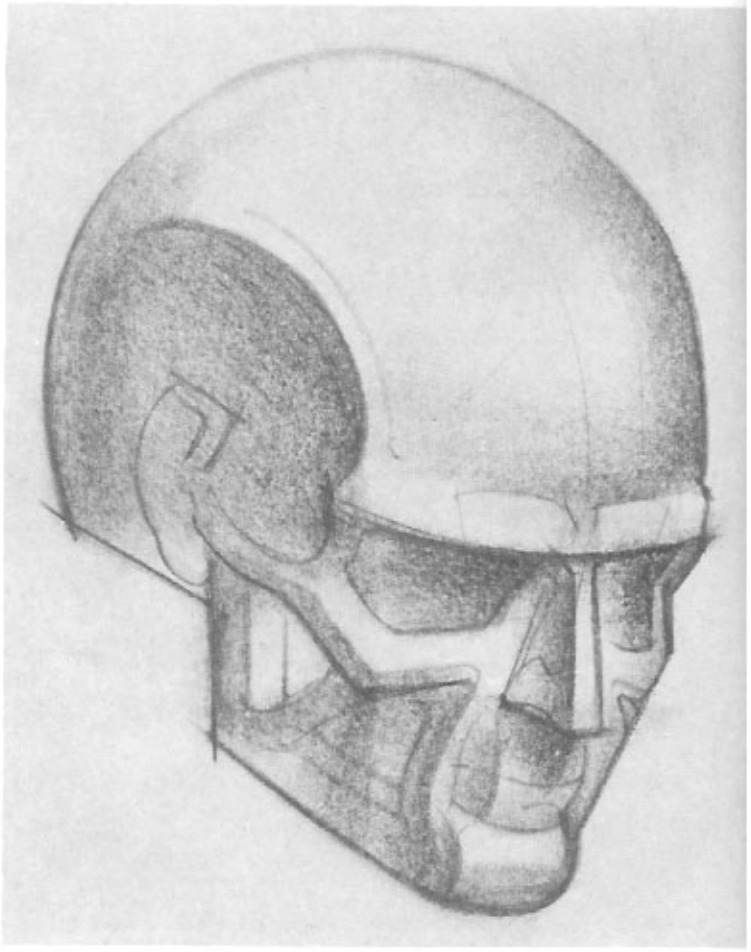


The great masses of the head with the secondary masses added. Three-quarter view.

2. THE SECONDARY MASSES. In general, there are nine important secondary masses in the head, all of them concentrated in the facial area. They are: (1) the brow ridge; (2) the tapered wedge of the nose; (3) the cheek bone; (4) the eye socket; (5) the barrel of the mouth; (6) the box of the chin; (7) the angle of the lower jaw, or jaw point; (8) the side arch of the cheek bone; (9) the shell of the ear.

Measurements: (1) The brow ridge — mid-distance from crown to chin; (2) The wedge of the nose — mid-point on the face from brow to chin; (3) The cheek bone — ends on a line drawn across the base of the nose; (4) the eye socket — opens at the brow ridge and ends on a line drawn mid-point across the nose; (5) The barrel of the mouth — begins at the nose base and ends two-thirds the

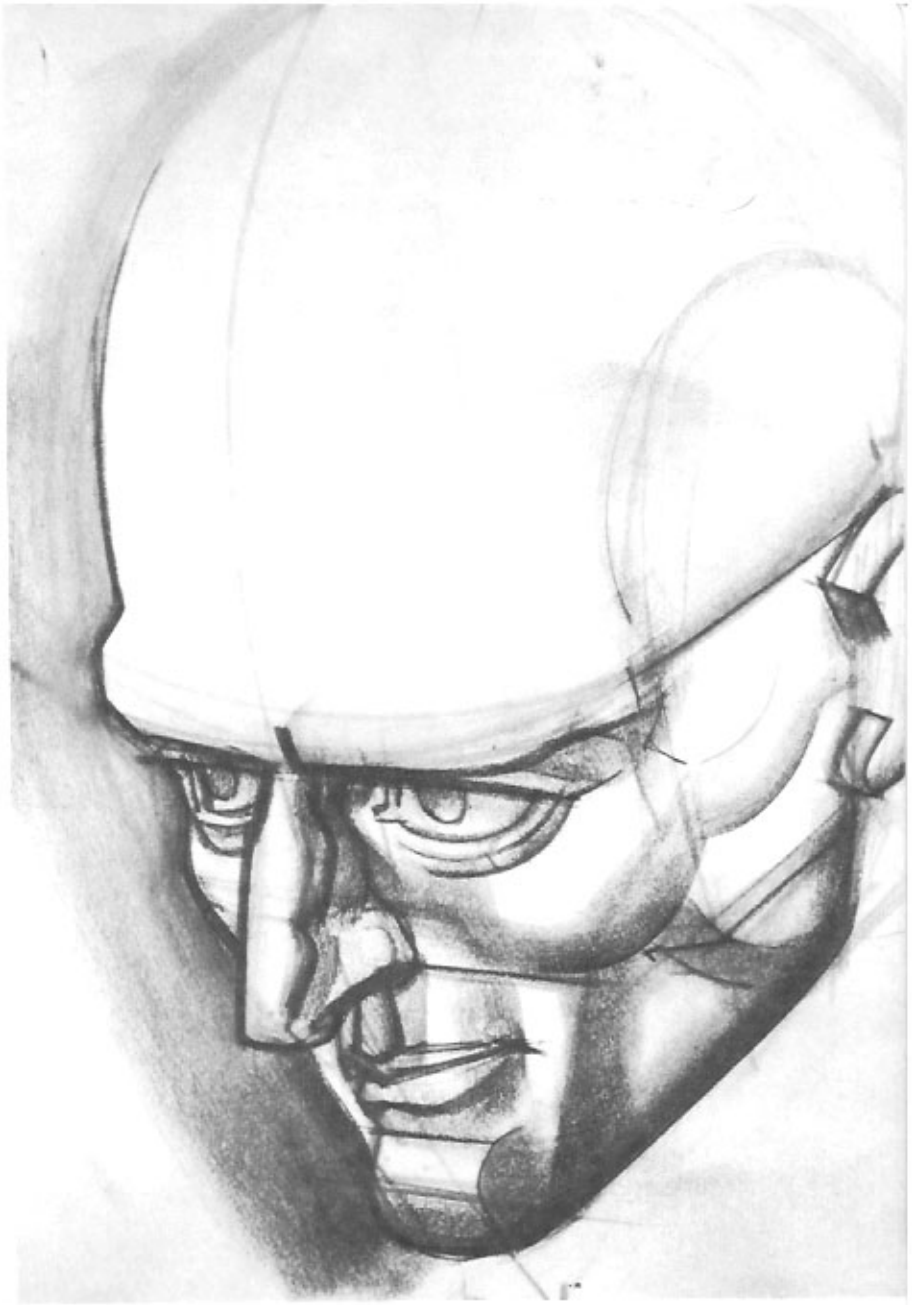


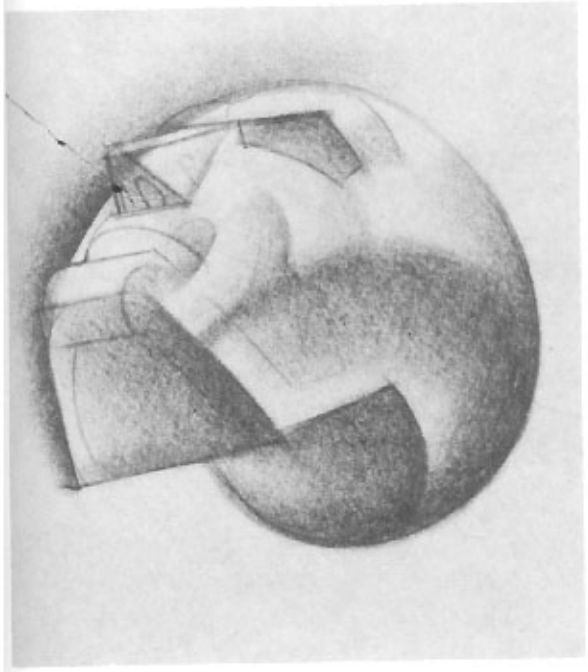


Positioning of the secondary facial masses.

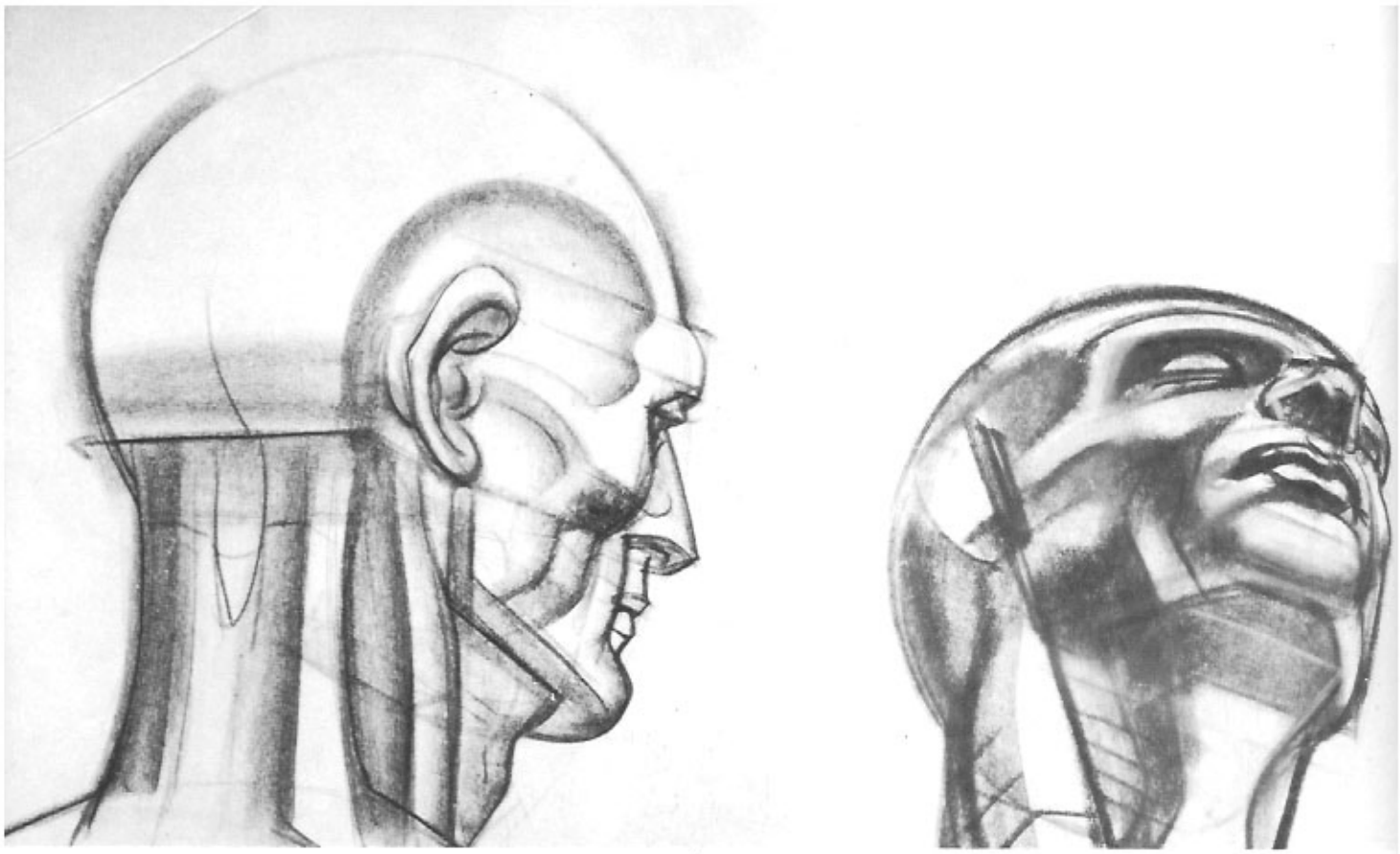
length down from nose to chin. The width of the barrel ends at points drawn directly under the centers of the eye sockets; (6) The box of the chin — the remaining third from nose to chin base; (7) The angle of the jaw, the jaw point — lies on a line drawn across the lower lip of the mouth barrel; (8) The side arch of the cheek bone — angles up from the cheek bone and attaches at the ear on a line drawn across the bottom of the eye socket; (9) The shell of the ear — fixed behind the jaw, lies across the positions of the brow ridge and base of the nose.

Location of the facial masses in variable views of the head. The brow at mid-point establishes the placement of smaller forms.

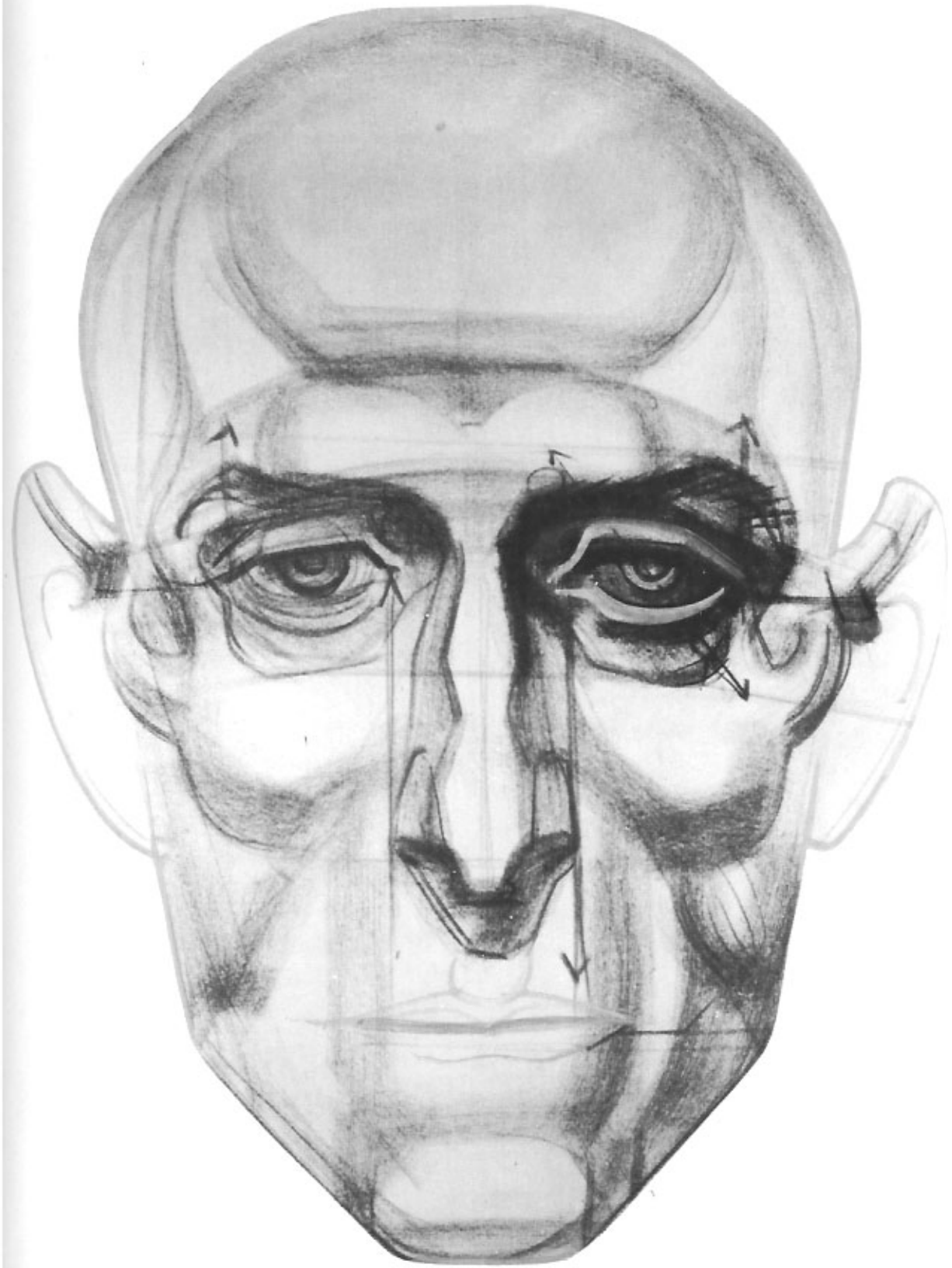








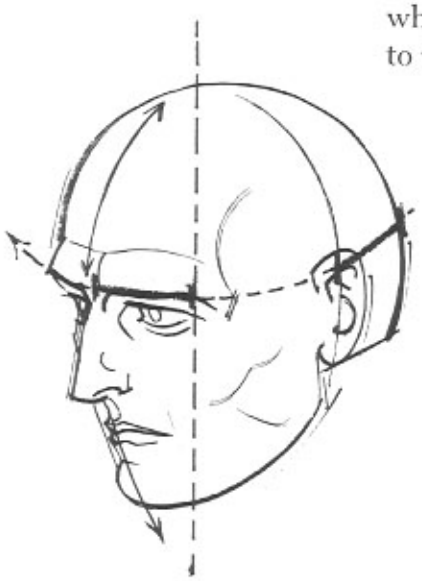
3. POINTS TO REMEMBER IN DRAWING: (1) The nose is as wide as an eye-length. (2) The head, front view, at the brow is 5 eye-lengths across the width. (3) The ear is tilted slightly back, at a 15-degree angle; it swings gatewise slightly forward from its attachment. (4) The bridge of the nose, the slant of the eye socket, the groove of the cheek bone toward its base, the point of the jaw, all lie on a 45-degree angle from the center of the head. However, when seen from a three-quarter view, the angle widens slightly as it curves around the head. (5) The lower lip is recessed under the upper lip; the lower denture is a smaller arch than the upper. (6) The lower eyelid is less arched than the upper; the upper eyelid lies on a wider curve of the eyeball. (7) The base of the nose, base of the cheek bone, base of the ear lobe, base of the skull, *always* lie on a line drawn across the head, from any angle of view. (8) The under-section of the jaw, seen from below, slopes down from the chin to the neck at a 15-degree angle; it looks like the wide end of a funnel jammed into the horseshoe of the jaw. (9) Note well: To place the eye correctly in its socket, start the corner of the eye on a line drawn *directly above* the end of the nostril; this will hold for *any view* of the head.

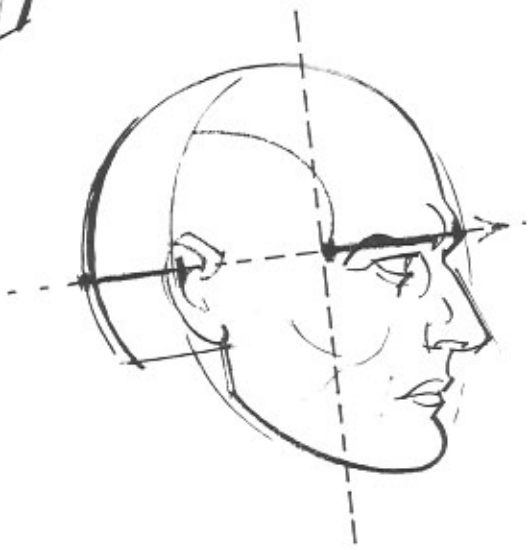




4. THE MOVEMENT OF THE HEAD. To *rotate the head* from a full front view to a three-quarter or seven-eighths turn, including the side position, the first problem which presents itself is the amount of the back of the head to be drawn in at specific stages of the rotation. The solution can be developed easily using the following procedure: (a) First draw a full front view of the head shape, no details. Now draw in the bisecting centers, vertical and horizontal lines, dividing the head in equal parts in both directions. (b) To make the head turn, place a *new center line* down the length at a three-quarter position from the first center line. (c) Measure the distance between the old and new center line. This is the *amount* of turn, or rotation of the head. (d) Take this exact measure and place on the head at the back. This will give the correct amount of shape to the skull corresponding to the amount of turn.

If the turn is increased, the increased amount will be added. Try it first right turn, then left. Notice, if the turn goes to the full side view, it will gain exactly at the back of the head what has been lost from the front. The same system can be applied to the up-and-down movement of the head. The change of line across the brow horizontally, when moved down to a new placement, will be measured and added to the top of the head.









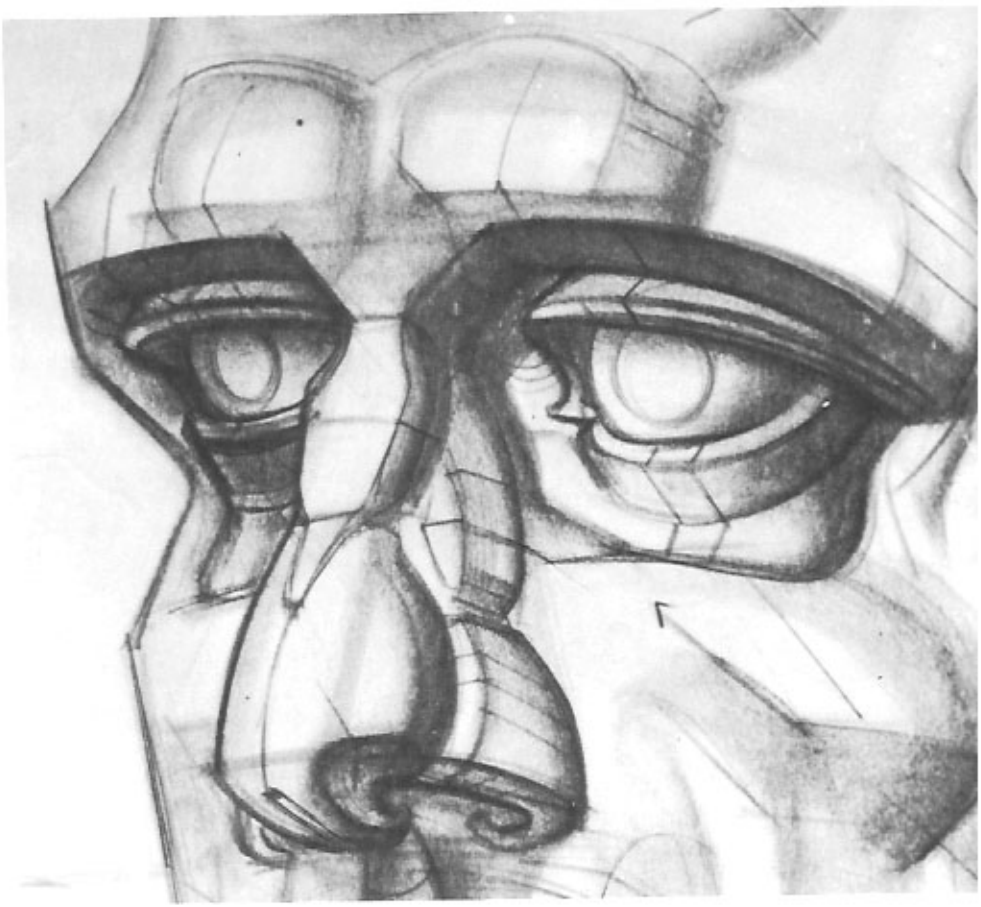
We must take note of a second problem in the rotation of the head – the *placement of the jaw line* on the head as it turns. Notice, as the head moves, in whatever position it is drawn, the jaw line tends to remain stable. The head as an upright ovoid mass, rotating on the neck, retains a *constant width* across the head as it turns. The jaw line width, therefore, will not change, no matter how much is added to the back of the head.



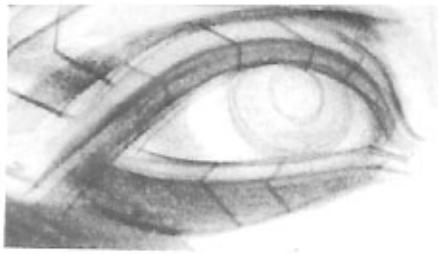
Let us consider a third problem in rotation — the *side plane of the head*, the form edge, moving from the temporal arch down the corner of the brow and cheek bone to the side of the chin. Observe how this edge tends to divide front and side of the face along a line drawn almost exactly in half between the lengthwise center line of the face and the jaw line. It will do this, in whatever turn position the head has been drawn because of the constant curves across the frontal mass of the face.

5. DETAILS OF THE FACE; THE FEATURES, MAJOR MUSCLE MASSES.

The Eye: The eyeball, almost as large as a golf ball, in the human head, is an exposed internal organ of the body protected by great structures of bone, the brow ridge (superciliary arch) and the cheek bone (zygomatic bone). It is suspended from the roof of the eye socket (orbit). The eyelids curve like short visors on the eye; the upper curves wider across the fuller circumference of the orb, while the lower turns on a shorter arc, around the base area. Seen from a side view, the lower lid lies angled down almost 45 degrees from the upper lid. Surrounding the eye is the orbicularis muscle, enclosing and circling the orbit. It gives little shape, however, to the surface form of socket and cheek bone.



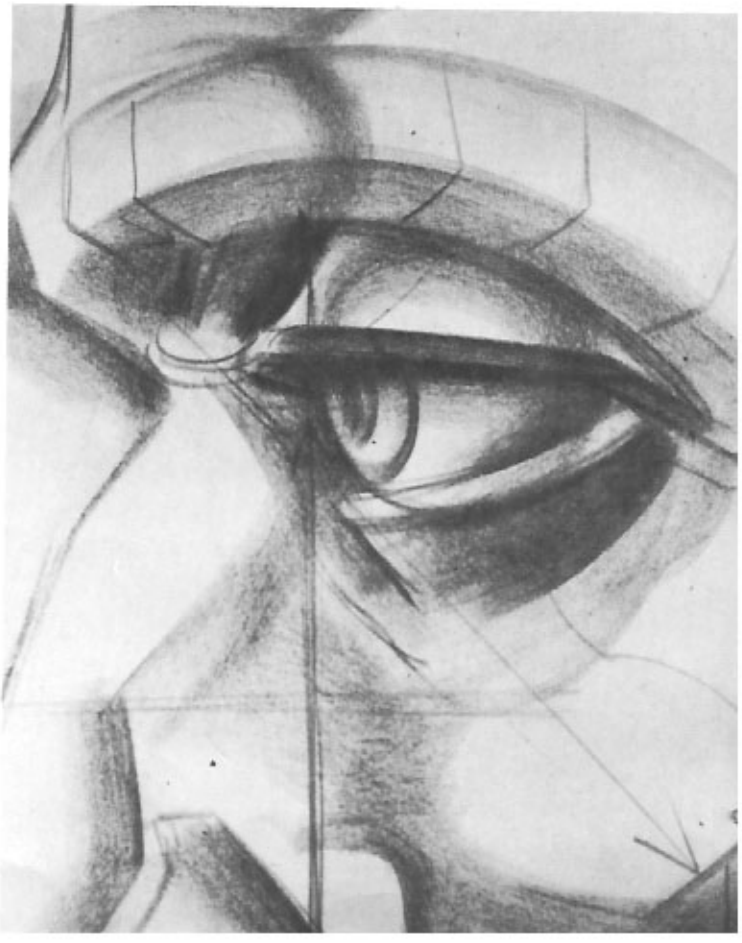




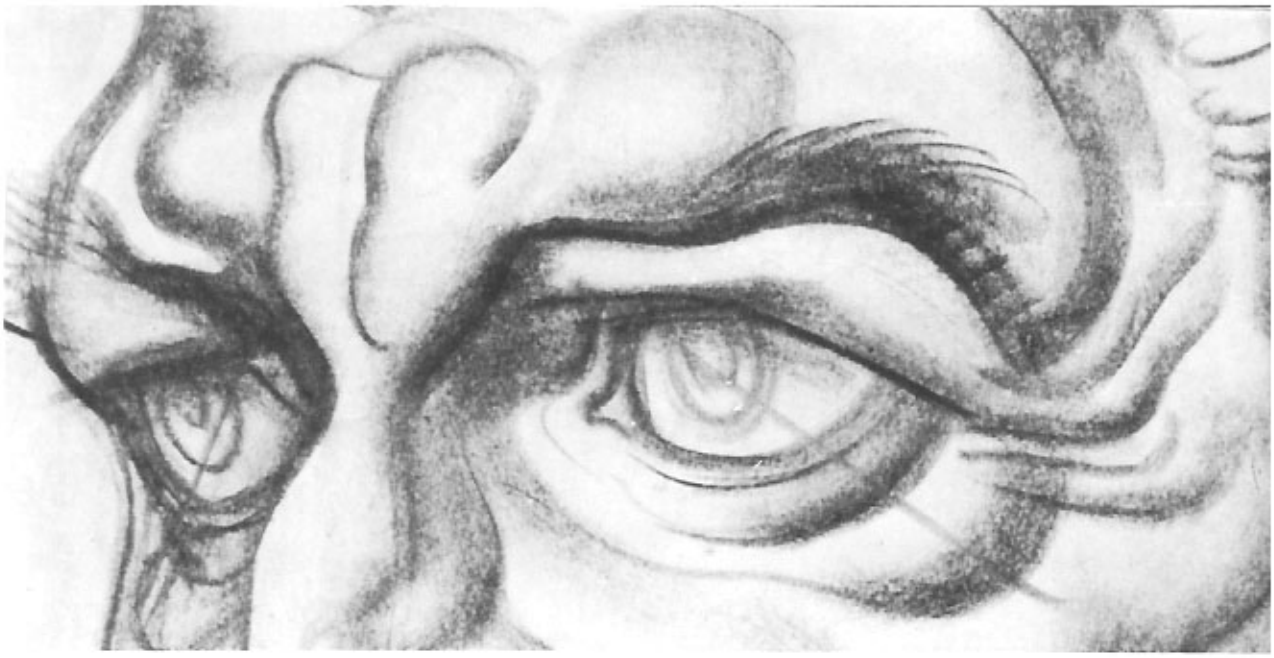


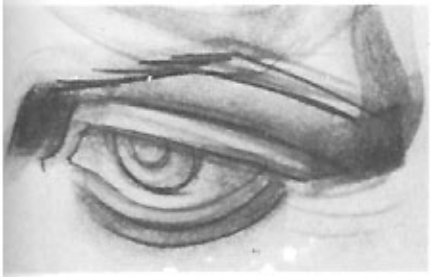


The eyelids appear as visors surrounding the orb.

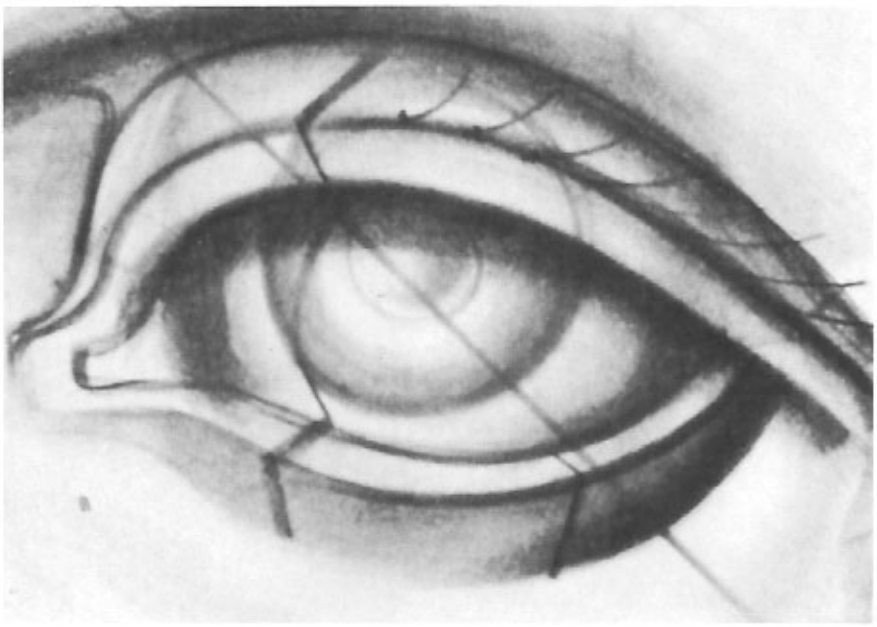


The eye position, side view, starts on a line drawn up from the nostril wing.





The axis of the eye. The upper lid arches high inside the socket while the lower lid curves to the outside of the socket.

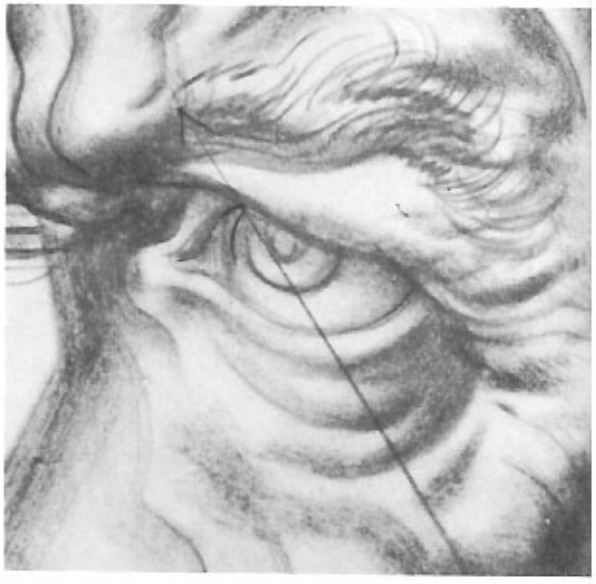


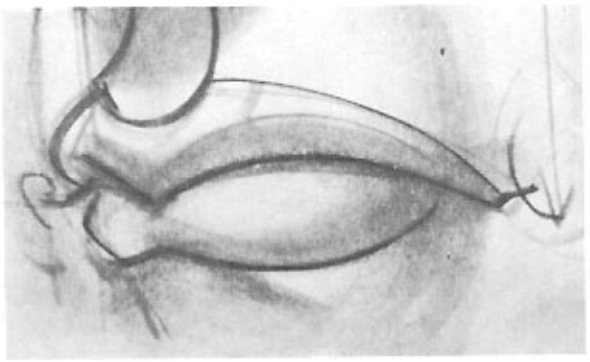
The eye is deeply set within the surrounding structures of the brow and cheek bone.

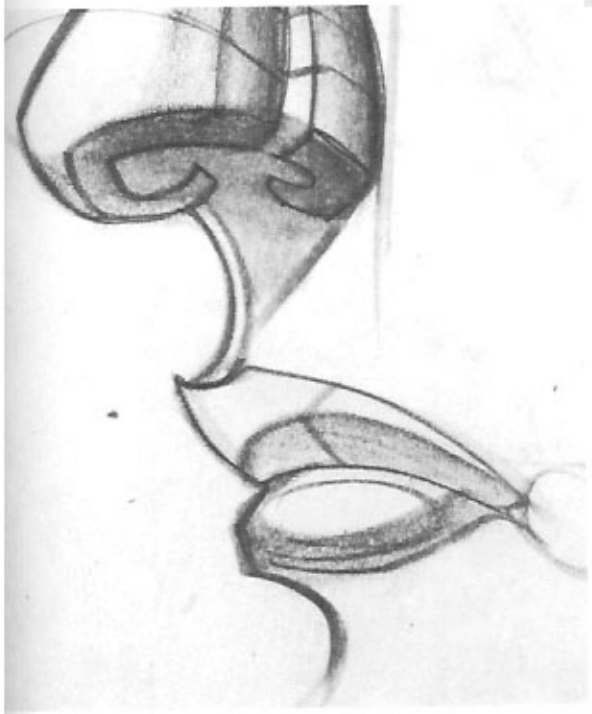




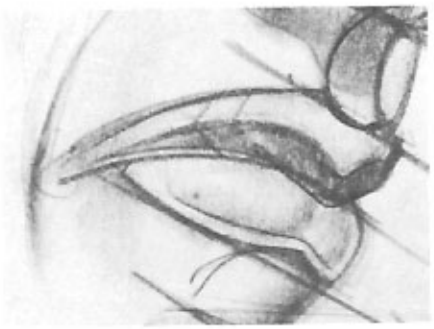


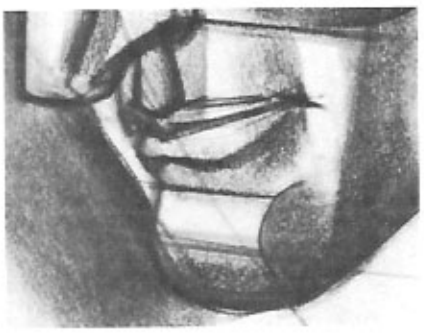


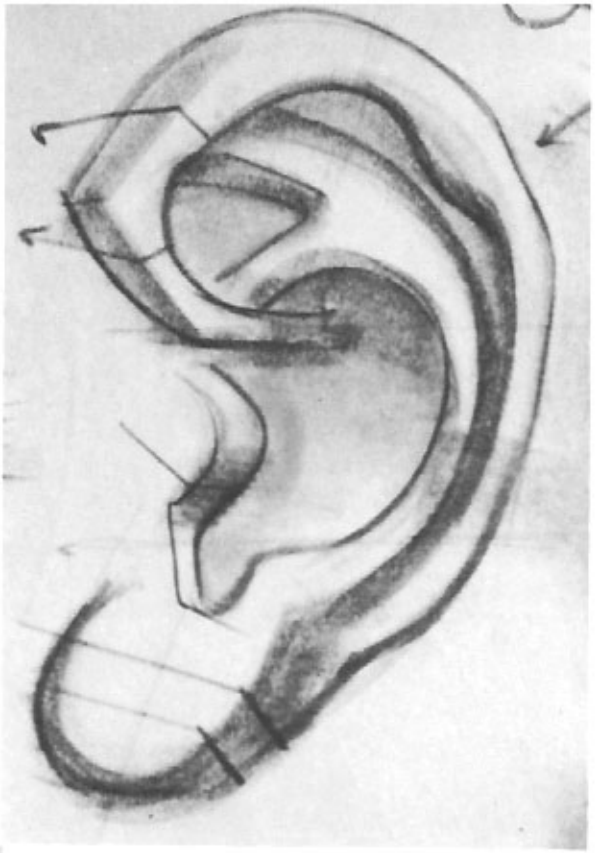
















The ear divides into equal thirds lengthwise.



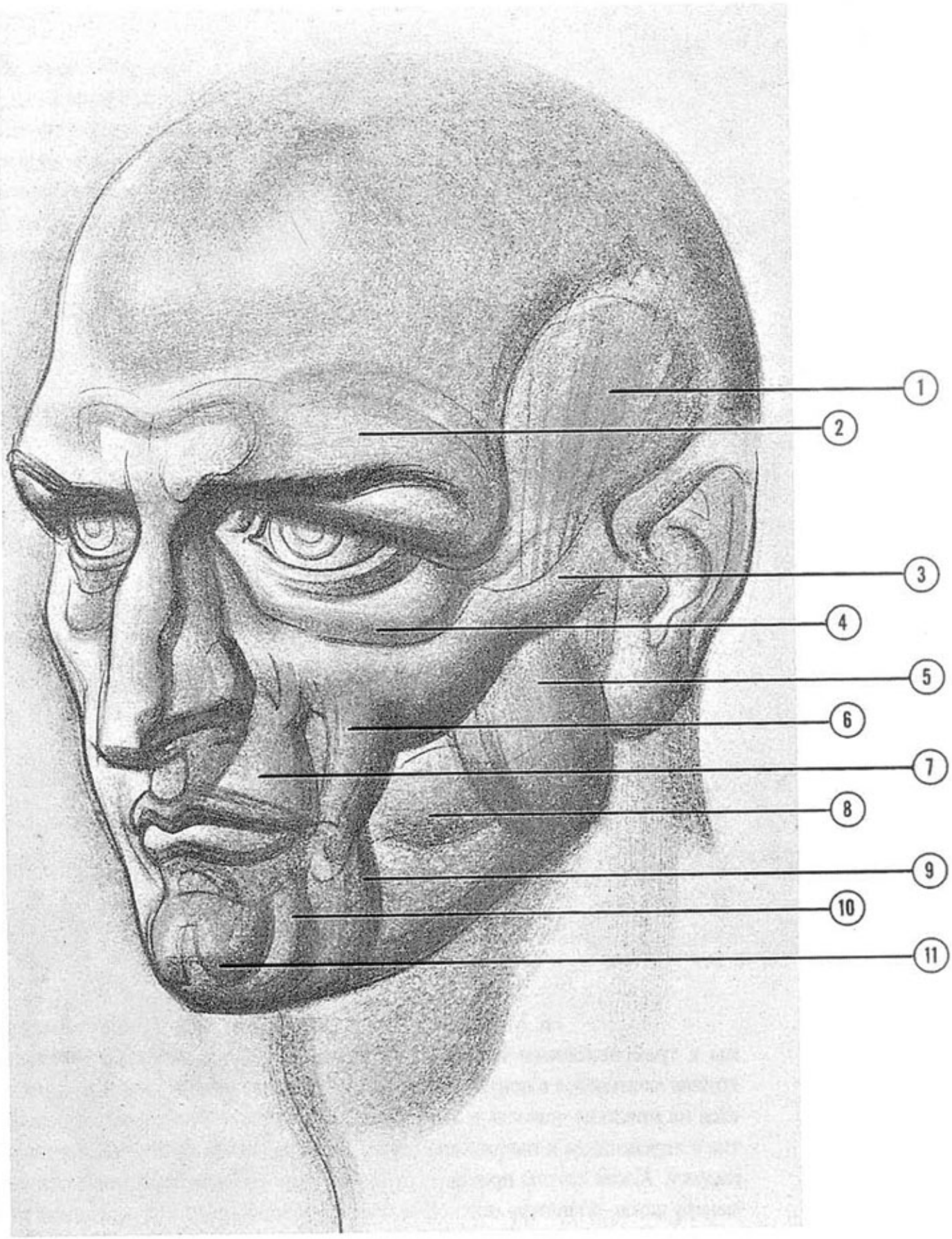
The Ear: The ear is shaped like a shell, wider at the top rim, narrower at the lobe. It consists of four major shapes: the outer wider rim (helix), the inner rim (antihelix), the cover of the ear opening (tragus), and the lobe (lobule). The ear can be divided into equal thirds lengthwise: first, at the upper rim where it enters the bowl of the ear; second, the length of the tragus; third, the fleshy lobe. The inner rim is divided at the top into two arms and shaped like a bent "Y." Emphasis in drawing should be given to the hard forms of the cartilage, and softened on the fleshy lobe. The bowl of the ear should be drawn large enough to accommodate a thumb.





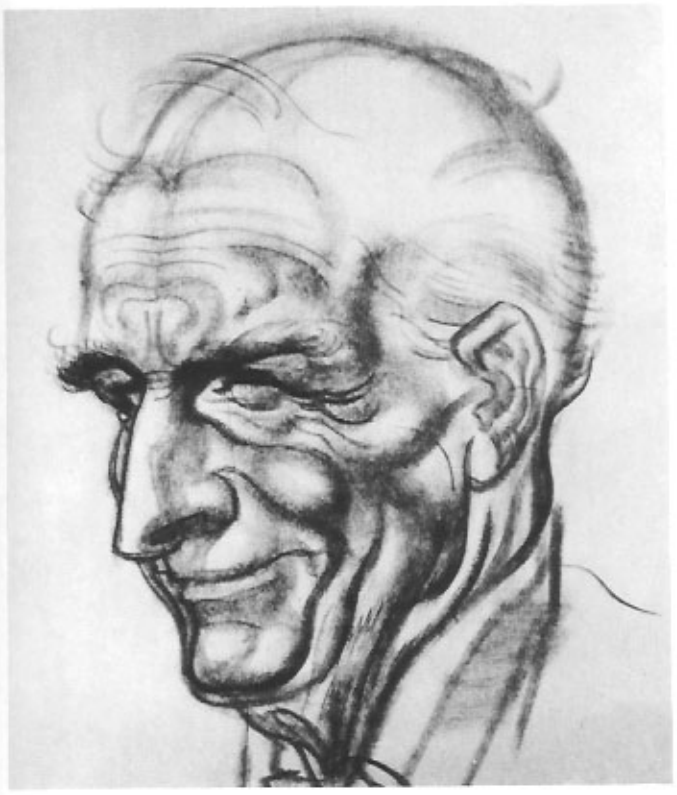
The Major Muscle Masses: The muscle masses which give shape to the face are grouped for simplicity in drawing and articulation of form. The strong masseter muscle, locking in the angle of the jaw from the cheek bone, controls the form of the wide part of the cheek. It completes the 45-degree contour line of the inner orbit of the dropping eye, from the bridge of the nose, obliquely across the face, to the jaw point. The zygomatic muscle starts angularly down from the front of the cheek bone to the outer upper curve of the mouth. The crease around the mouth is the edge of this muscle. The buccinator completes the crease at the tight knot in the corner of the mouth and moves across to the jaw, under the masseter. Because it is deep-set, it shows as a depressed area in the middle of the lower cheek. Triangularis, at the wide outer part of the chin, moves from the corner of the mouth to the front jaw. Quadratus starts under the lower lip and slants toward triangularis on the front jaw protrusion. The cleft in the chin is thus exposed. The temporal arch, the somewhat hollow area of the temple, lies above the zygomatic or cheek bone arch and to the side of the brow ridge. Although it is filled in with a broad flat mass, the temporal muscle, it is still depressed enough to receive the bulge of the upper palm of the hand. The forward edge of this muscle exposes clearly the temporal line, the side plane of the forehead.

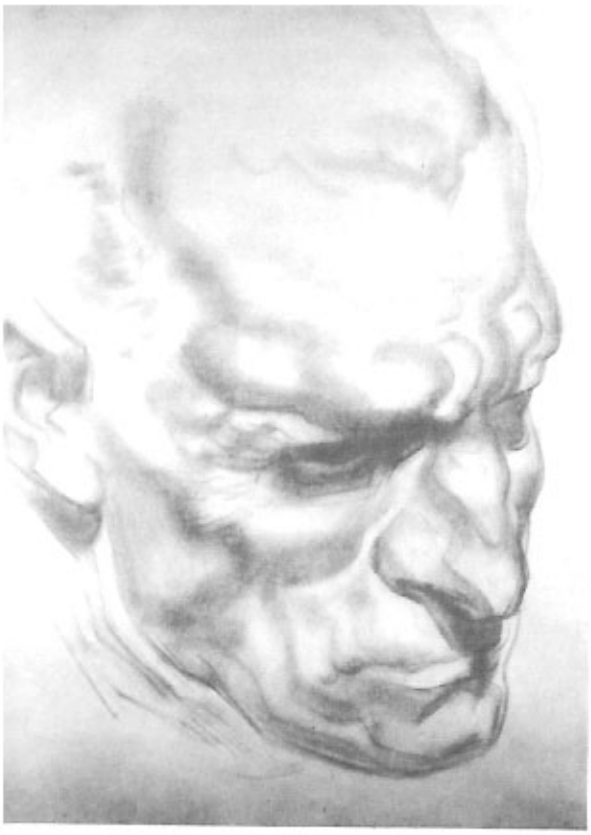
1. TEMPORAL
2. FRONTALIS
3. ZYGOMATIC ARCH
4. ORBICULARIS OCULI
5. MASSETER
6. ZYGOMATICUS
7. ORBICULARIS ORIS
8. BUCCINATOR
9. TRIANGULARIS
10. QUADRATUS
11. MENTALIS


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On the brow, it rings the bulge of the frontal sinus above the eye and forms a curved movement across the middle of the forehead. The *lateral group* starts at the outer corner of the eye, the crow's-feet, and spreads backward to the ear, down to the masseter muscle and around the jaw point to the neck. Upward, the crow's-feet wheel around the outer edge of the brow and thrust high in thin wrinkles toward the front forehead. These are the major wrinkle patterns, usually developed in the deep recesses of bone and channels between muscles. Variations according to age and muscular flaccidity will account for refinements in the drawing of particular individuals.





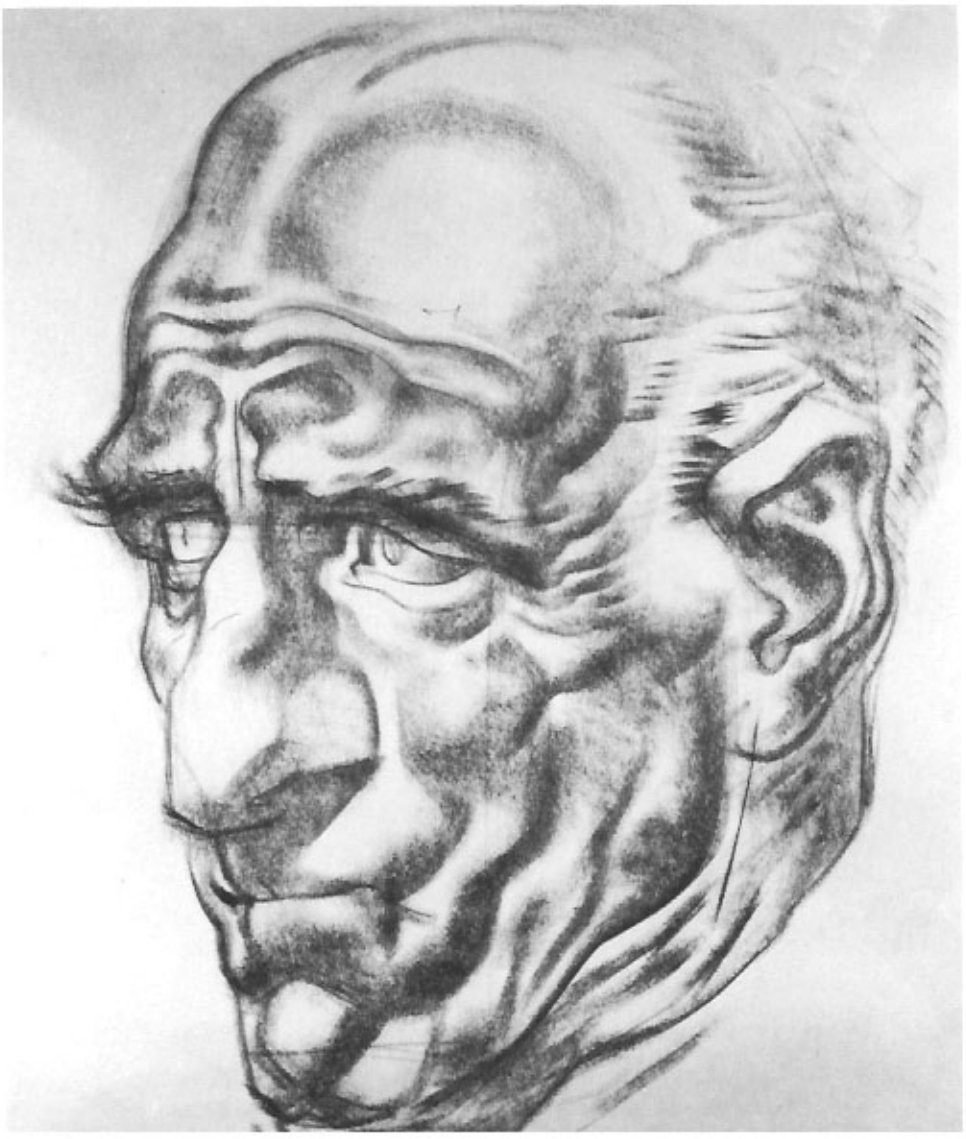




The three basic head types. The broad head—brachycephalic; the round head—mesocephalic; the long head — dolichocephalic.



7. FACIAL CHANGES AND CHARACTERIZATION. In form structure, the head generally shows three basic shapes or variations: the long head or dolichocephalic, the round head or mesocephalic, and the broad head or brachycephalic. These are the variants from which the artist can observe individual minor characteristics. We may observe that long heads generally show elongations of form in nose, ears, chin; that broad heads reveal squared, broad forms. However, individual differences show a remarkable variety of digressions from accepted ideas of form. The individual has his unique qualities and these should be observed against the background of general knowledge. The variety of heads presented here shows how the study of the individual has dictated the interpretation of character and the manner of expression.

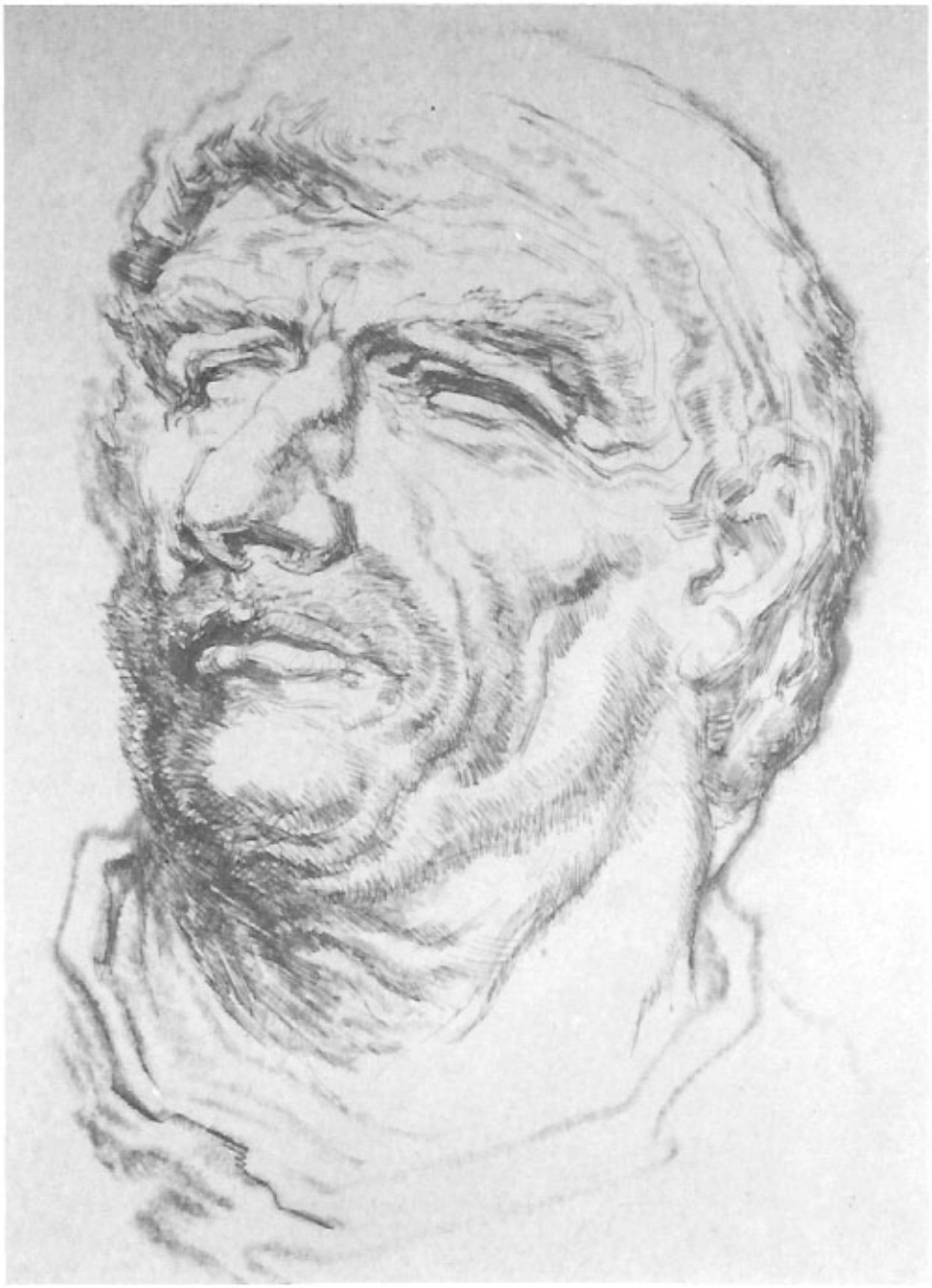




Mexican woman. Watercolor. *(opposite) Beethoven. Ink and wash.*







(opposite) Old man. Ink through water.

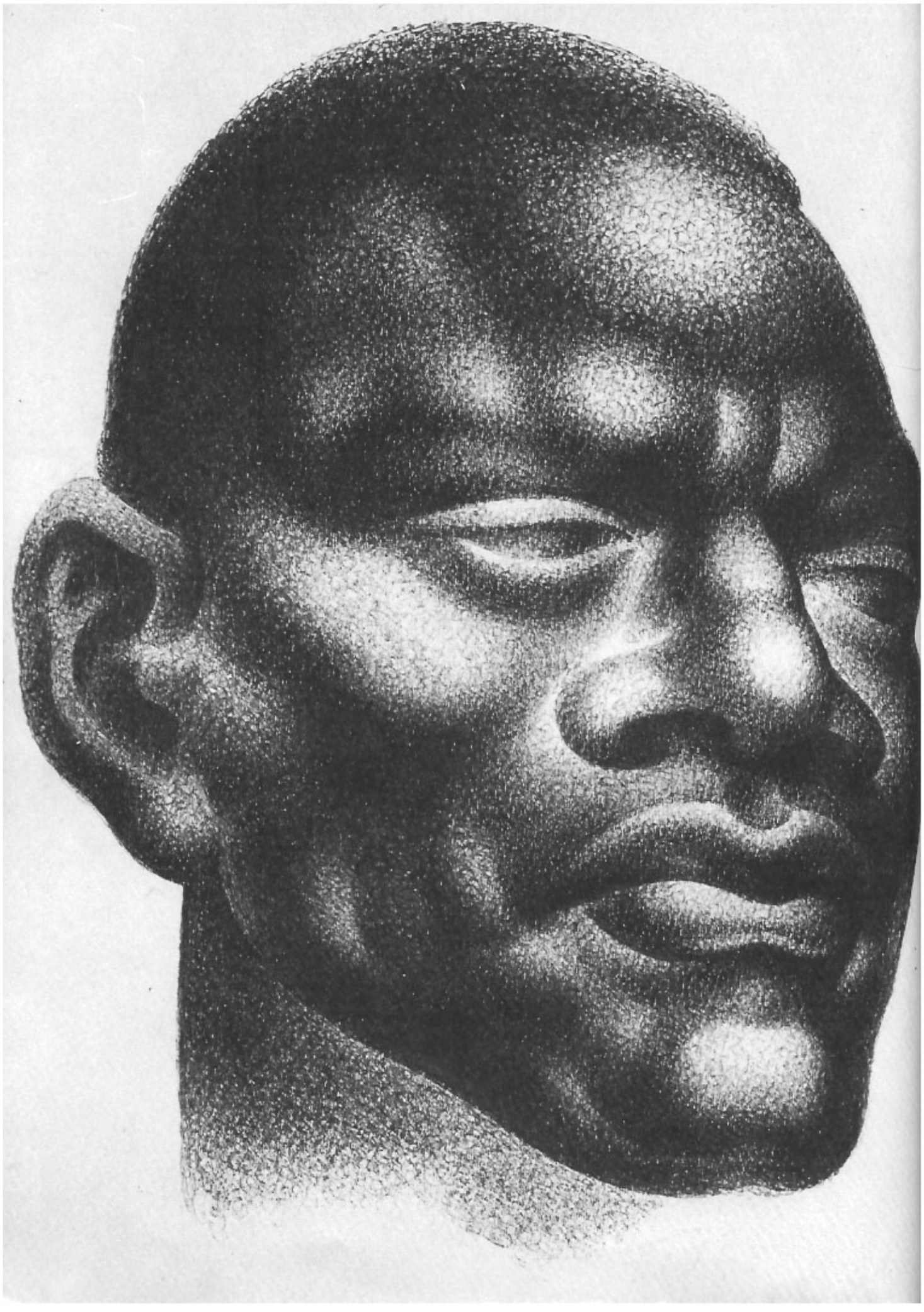
Saul. Ink and crayon.





(opposite) Patriarch. Pastel.

Blind man. Ink and color.





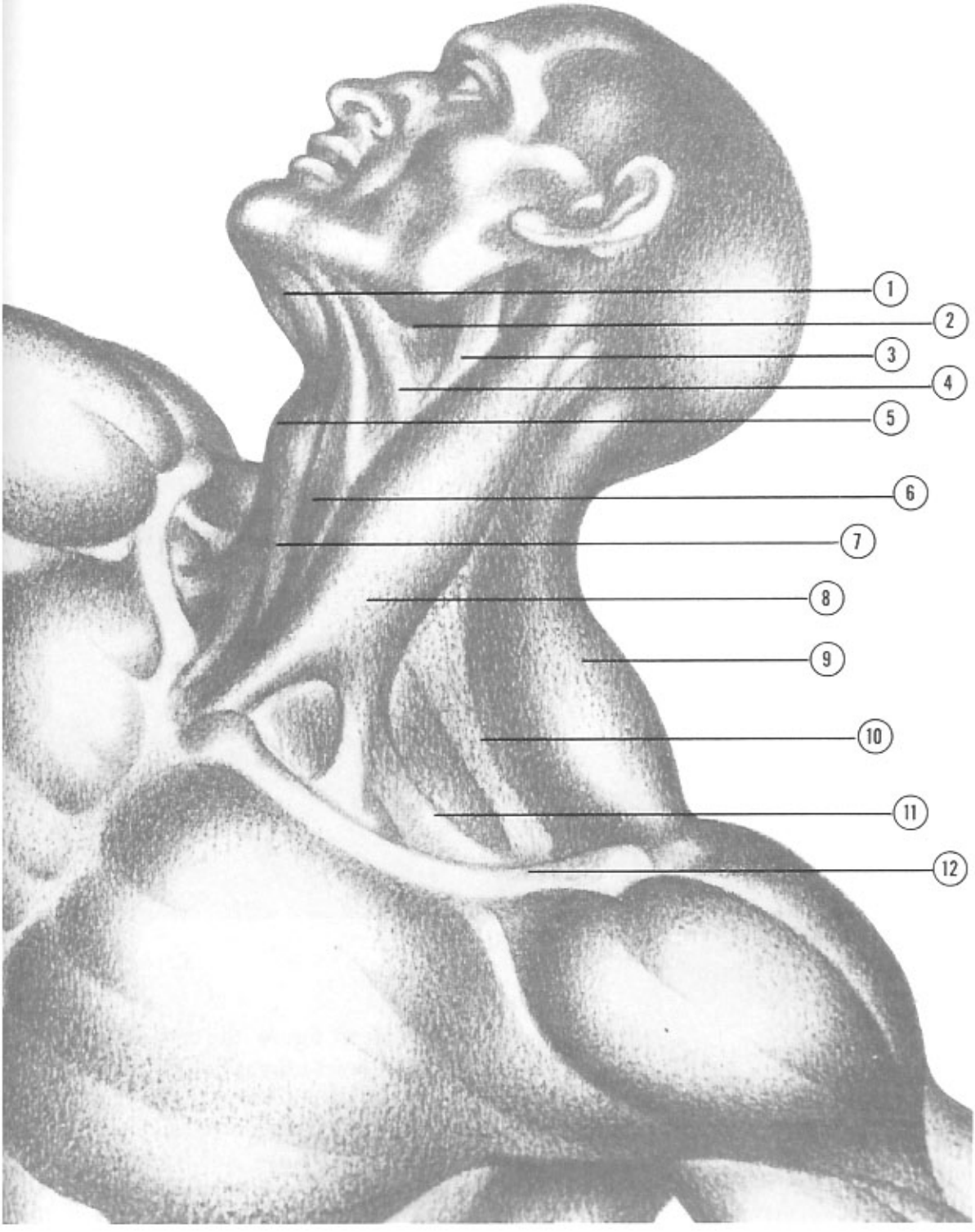
(opposite) Negro. Ink, scribble technique.

Jake. Colored ink.

THE NECK

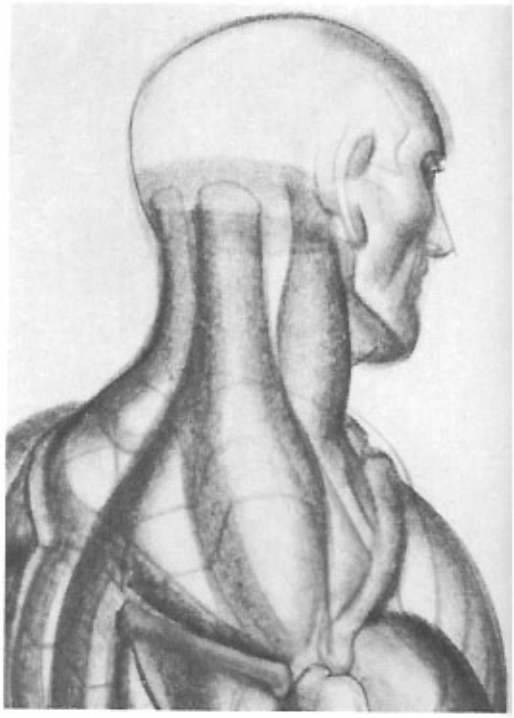
1. THE MASSES. The column of the neck originates at the base of the skull and curves back and downward in a large arc to a position ending at the collar bones. In the back of the neck, quite low, the projecting spinous process, a hard tuberosity of bone, can be felt with the palm, in the middle recess between the shoulder muscles. This projection identifies the beginning of the rib cage to the rear. To the front, the column ends at the acclusion of the clavicles, the collar bones at the pit of the neck. The neck column consists of five important masses. They give shape and form to the neck. When they are drawn badly, the form is destroyed. Further, the cervical vertebrae, the seven neck bones, have no external form-producing effect whatsoever. The five neck shapes are: the middle tracheal funnel, starting from the wide slope under the jaw and tapering to the upper box of the larynx, the Adam's apple, and wedging into the pit of the neck; the two side, winding masses of the sternomastoid, moving out from behind the ear to the front collar bones; the two back neck muscles, the upper arms of the trapezius, attached to the base of the skull and widening onto the back shoulders. These groups are easily observed and retain their distinctive forms in all manner of views. The trapezius, seen frontally, has a deep fossa or trench between its thick form and the collar bone.

1. DIGASTRIC ANTERIOR
2. SUBMAXILLARY GLAND
3. STYLOHYOID AND DIGASTRIC POSTERIOR
4. HYOGLOSSUS
5. LARYNX
6. OMOHYOID
7. STERNOHYOID
8. STERNOMASTOID
9. TRAPEZIUS
10. LEVATOR SCAPULAE
11. OMOHYOID
12. CLAVICLE

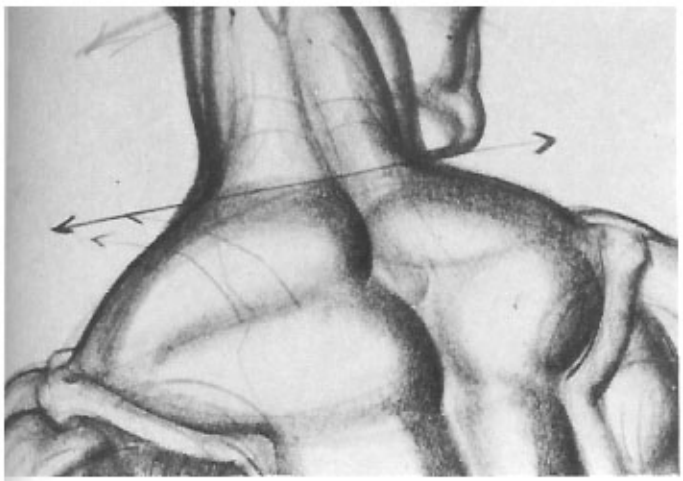

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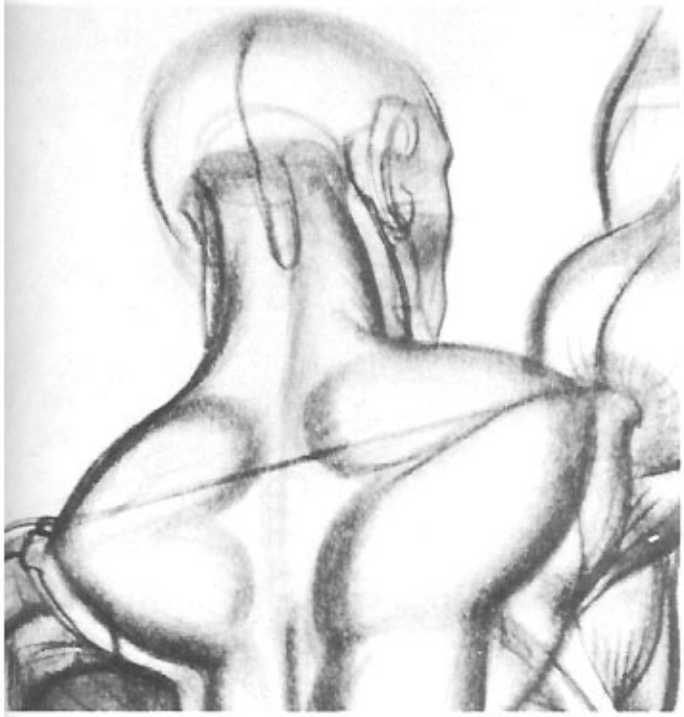
The major masses of the neck.

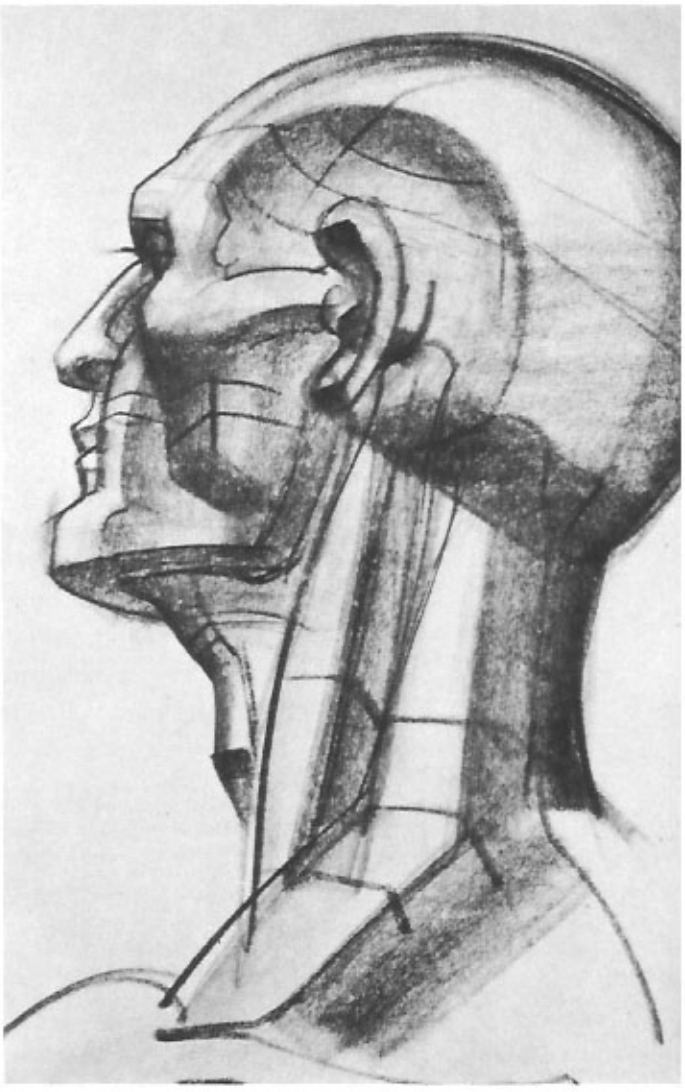


2. MEASUREMENTS. In the erect figure, the neck from the front is one-half head in length from the jaw to the pit of the neck. From a side view, the neck meets the jaw mid-point between the chin contour and the jaw point. The width of the neck, frontally, is not quite as wide as the jaw. However, on the line of the Adam's apple, just under the jaw, the sternomastoids begin to compress while the trapezius broadens across the shoulder area.



The seventh cervical vertebra positioned across the line of the shoulders.





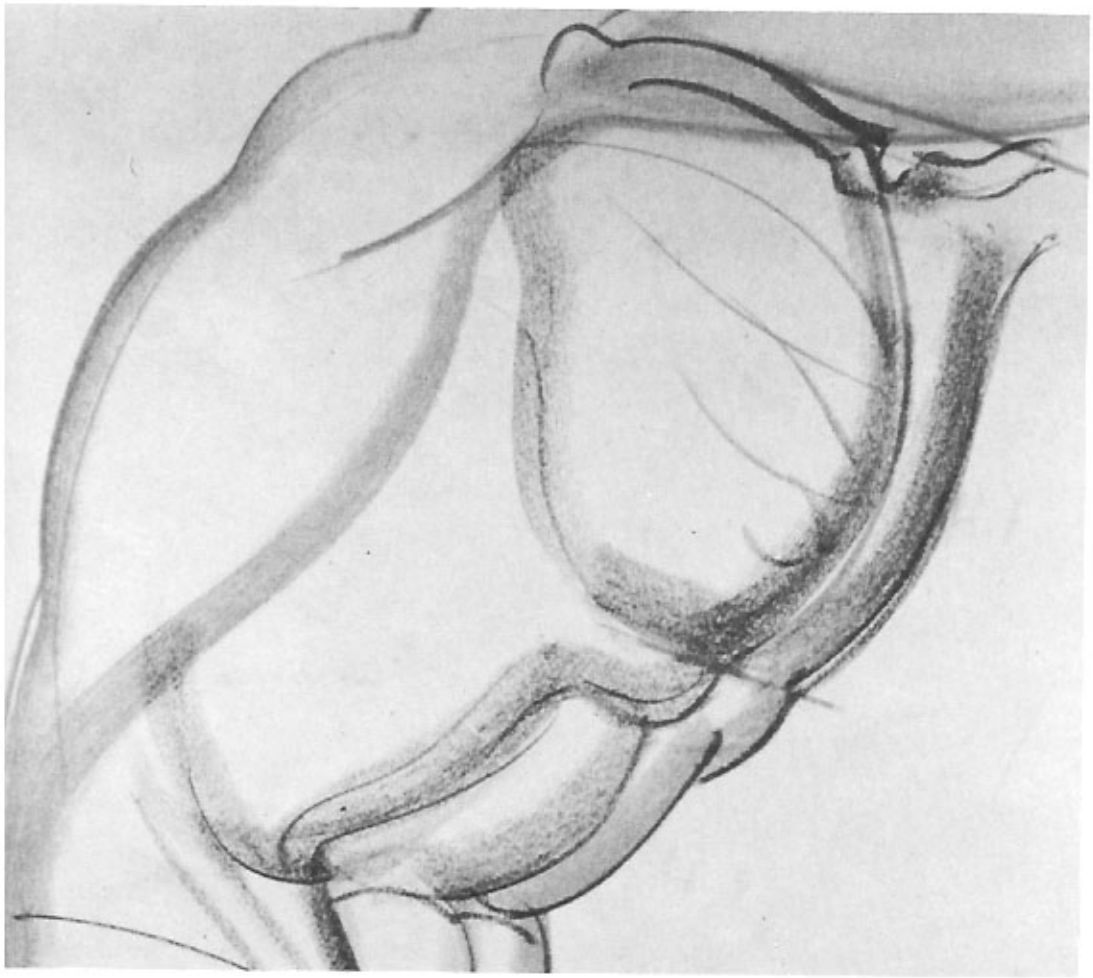


3. POINTS TO REMEMBER IN DRAWING. The head in turning, twisting and stretching movements, constantly pulls the neck with it as it moves. It is wise, therefore, to observe the position of the chin and its direction in the drawing. The neck, as a rule, invariably follows the action position of the chin. If the head twists, the neck will twist to follow the chin.

Because the above is true, the box of the larynx will tend to remain centrally located just under the jaw arch. Now, observe carefully: a line starting from the center of the nose, and drawn through the center of the lips, will continue down and drop onto the box of the larynx. This will invariably occur in almost every position of the head, from ordinary to extreme views, up or down. Thus, great control of head and neck relationship can be mastered without difficulty in placement.

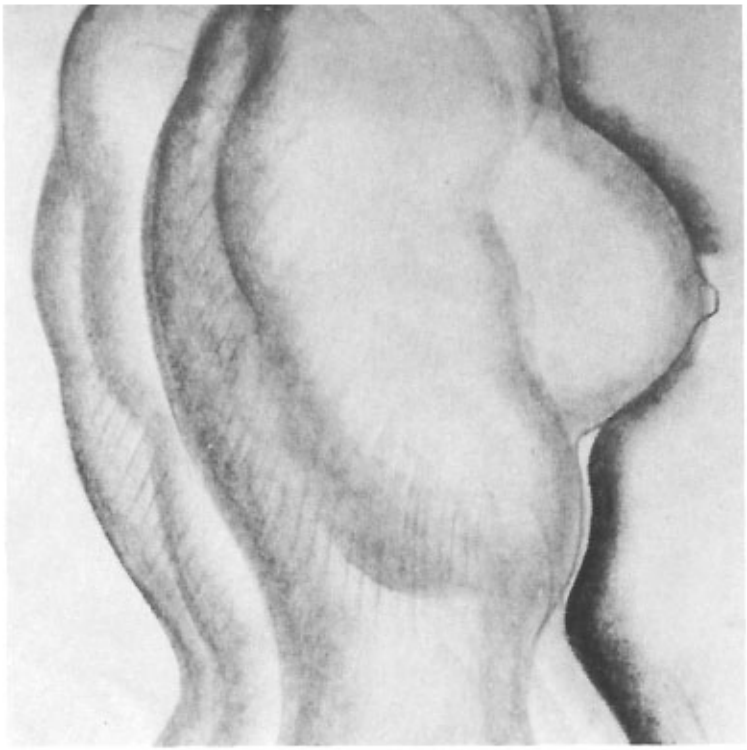
The head on the column of the neck acts like a floating, bobbing cork on water. The movement of the body tends to upset the head. But the head, controlling the activity of the body, acts like a gyroscope to oppose the movement of the upper torso. It is a good idea, therefore, to balance the head generally in *opposition* to the action of the torso, unless, of course, the head must be shown otherwise for some special reason.





THE TORSO

1. THE UPPER TORSO MASSES. The upper thoracic mass of the torso, the rib cage, is shaped like a wedged box; broad across the collar bones, it descends and compresses to the rib base above the elbows. The entire wedge is balanced like a box tipped backward on its edge at a 15-degree tilt. The entire length in this position is one and two-thirds heads long. The front slope of the chest is thrust forward the length of a head to the diaphragm arch and tapers two-thirds of a head to the base of the cage. The back slope on the trapezius is thrust only two-thirds of a head backward, and compresses one full head length down to the rib base.



The forward slope of the upper torso mass.

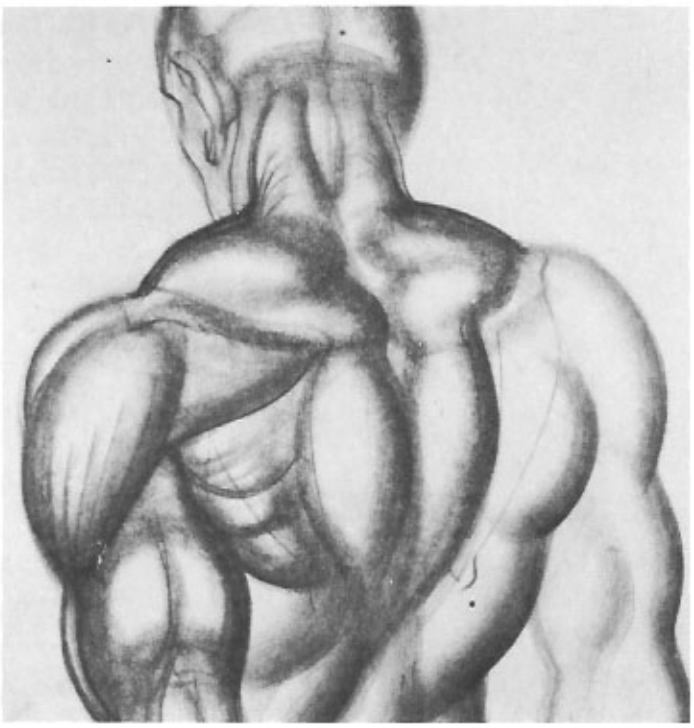






The front torso descends a head length to the diaphragm arch.

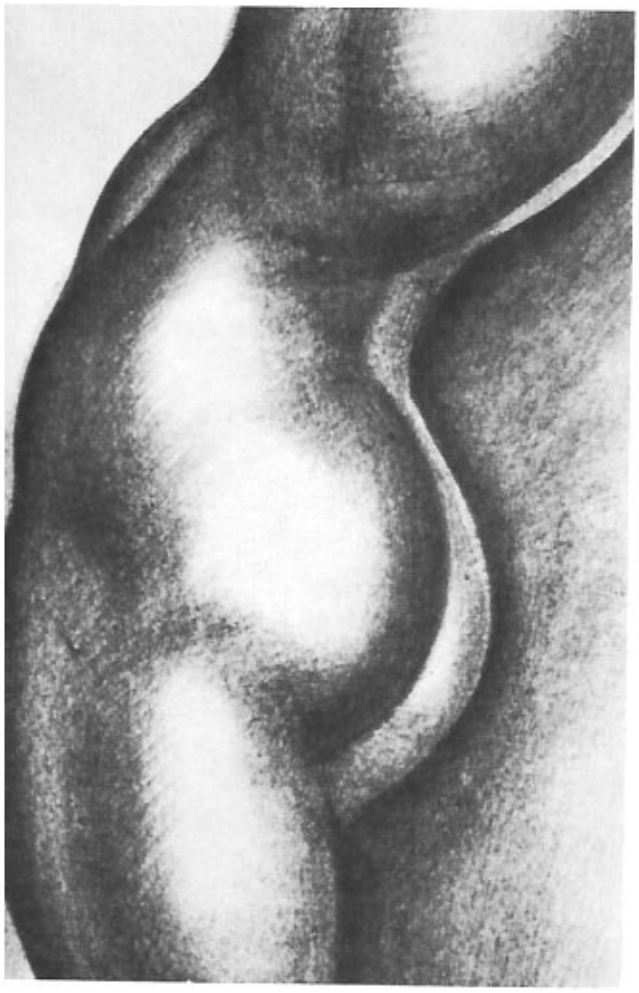




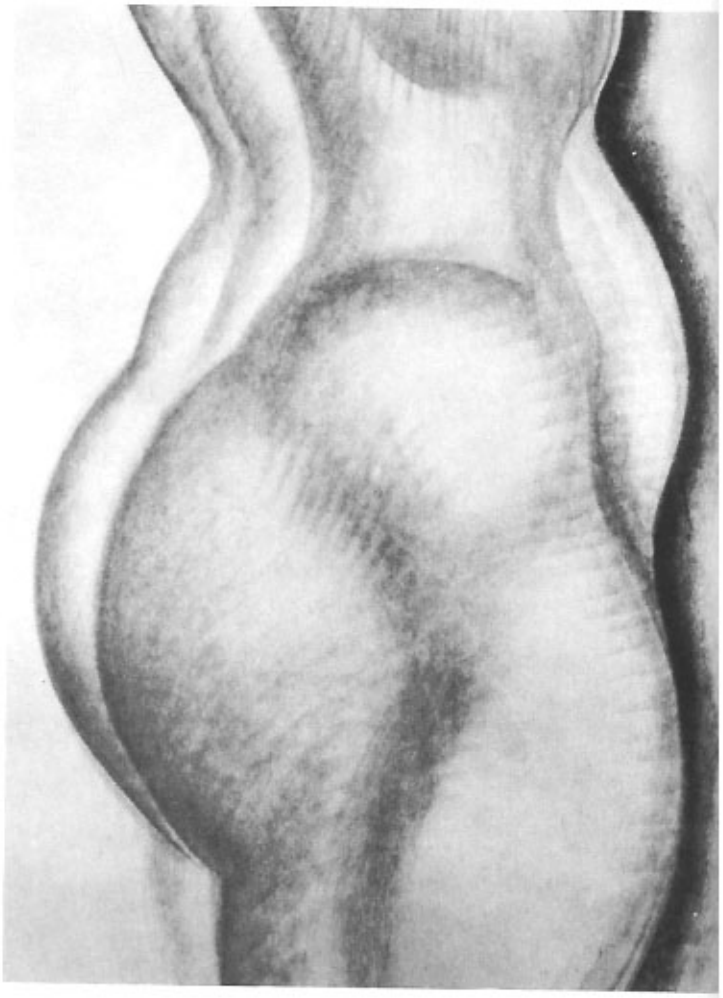


The steep descent of the back torso from the short shoulder line.

2. THE LOWER TORSO MASS. The lower mass of the torso, the pelvic mass, is shaped like a flattened wedge-box, narrow at the waist and wider at the buttocks. The mass is tipped forward at the abdomen and slopes backward at a 15-degree angle, opposing and balancing the movement of the rib cage. The two masses are separated by a space one-half head in length, from the rib cage to pelvic girdle.

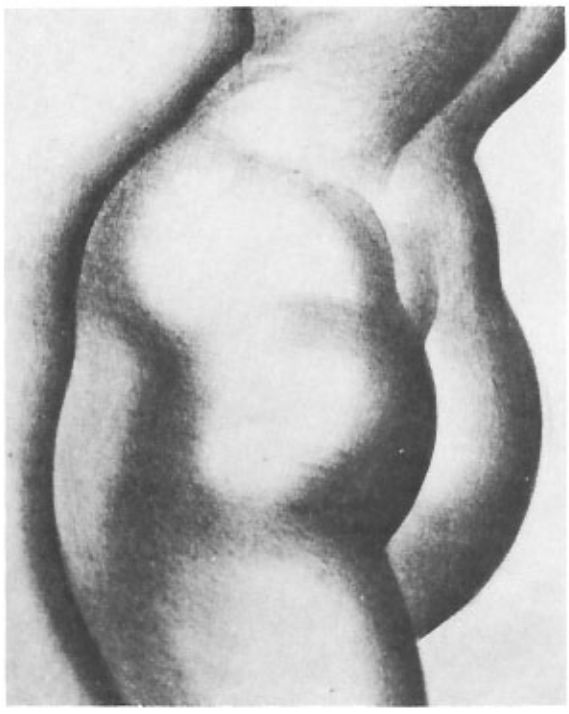


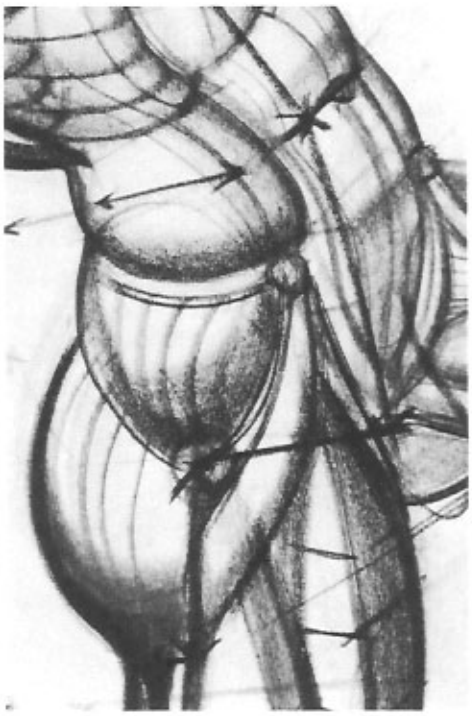
The backward tilt of the pelvic mass.



The mid-axial region of the torso: the pelvic mass balances and opposes the upper torso in movement.

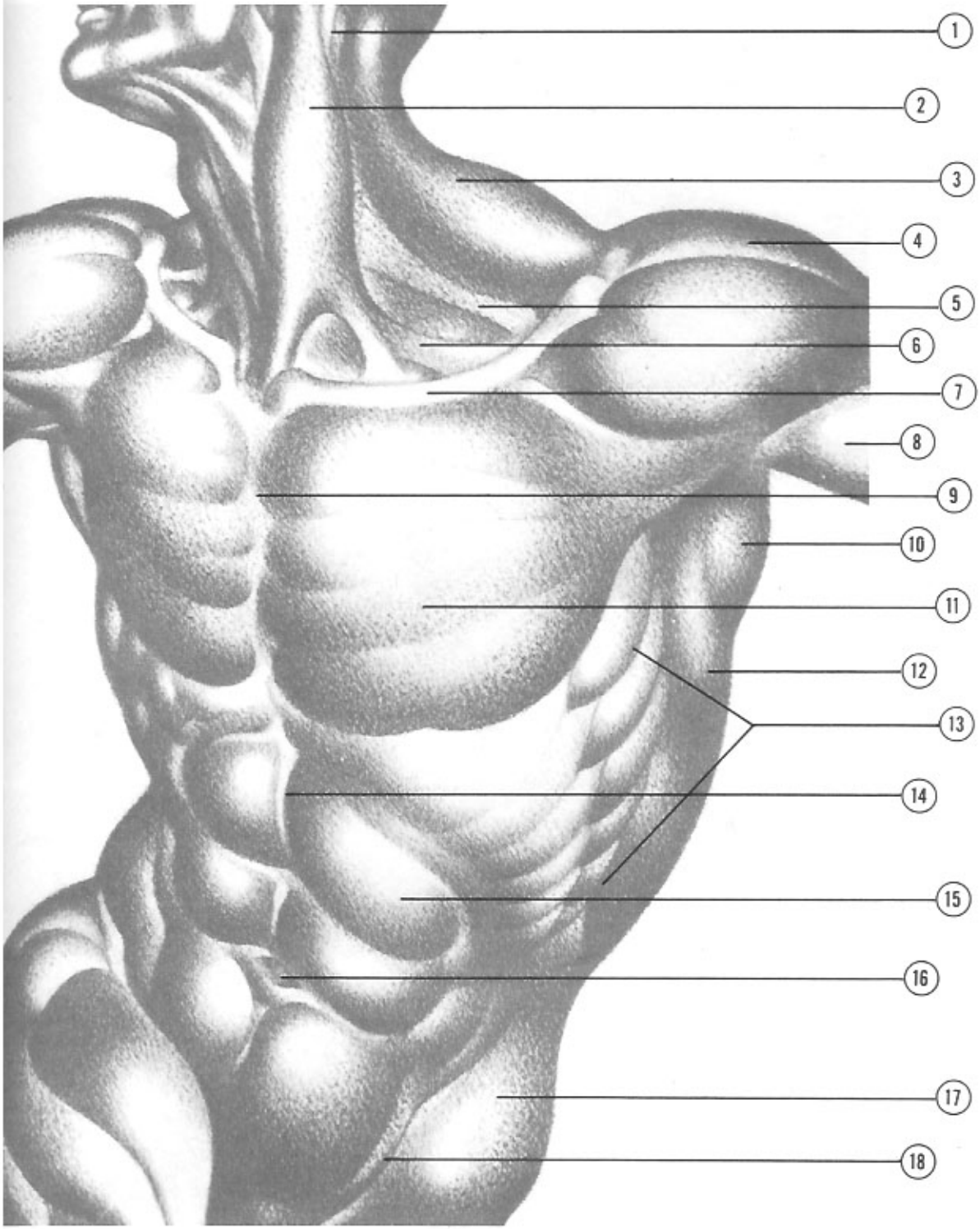


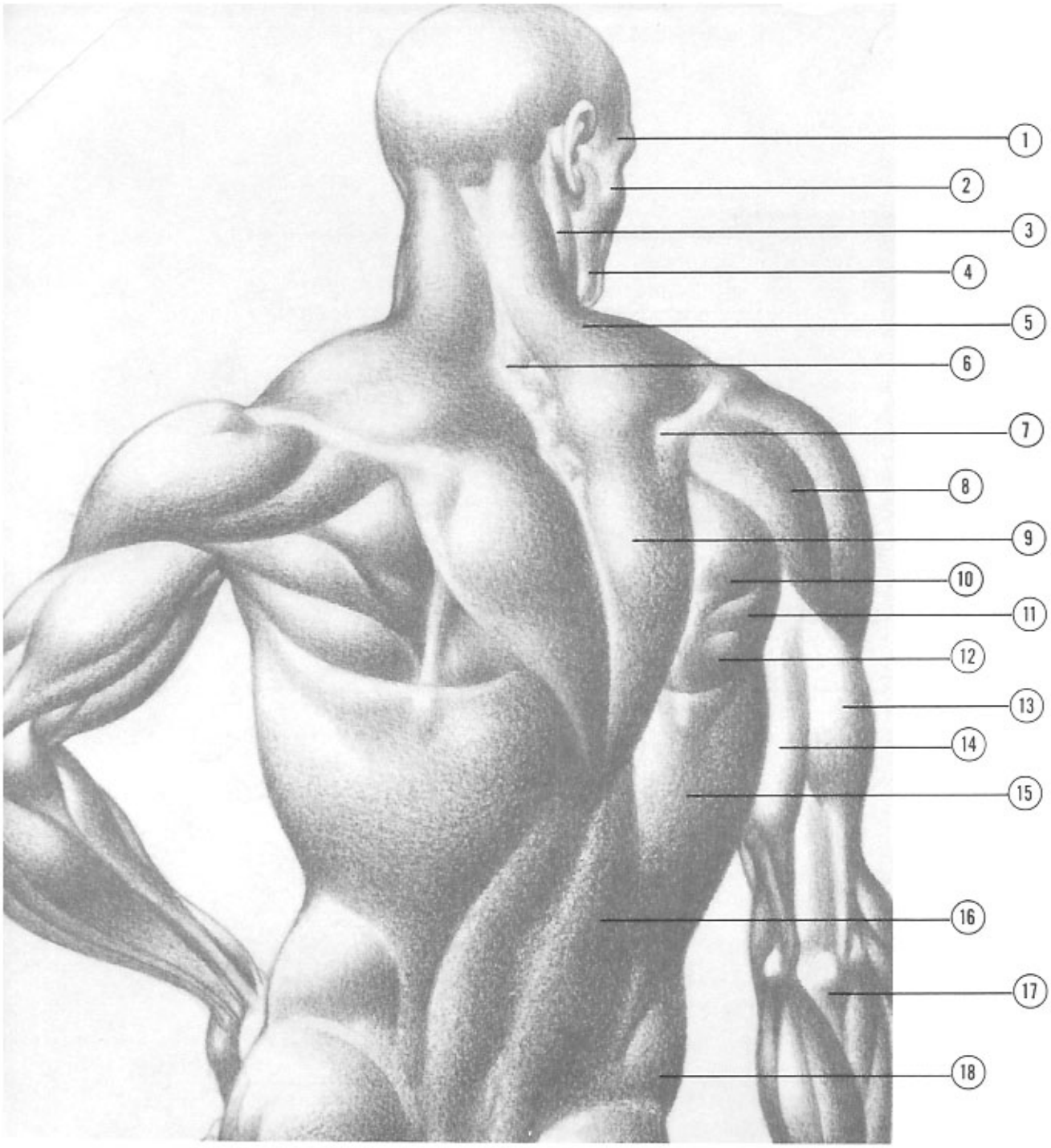




3. THE MAJOR MUSCLE MASSES. The front torso contains five important muscle masses: the two pectoral chest masses, divided centrally by the sternum; the abdominal mass, rectus abdominis, the sheath of the internal organs, divided into three tiers horizontally and two columns vertically by linea alba, revealing six sections; and the side support muscles connecting ribs and pelvis, the two externus oblique masses. The smaller muscles of the ribs, the serratus anterior group, lie transversely on the ribs under the pectorals. With the arms down, five serratus slots may be seen. With the arms up, a sixth becomes visible on either side of the rib cage high up under the borders of the pectorals in line with the nipples.

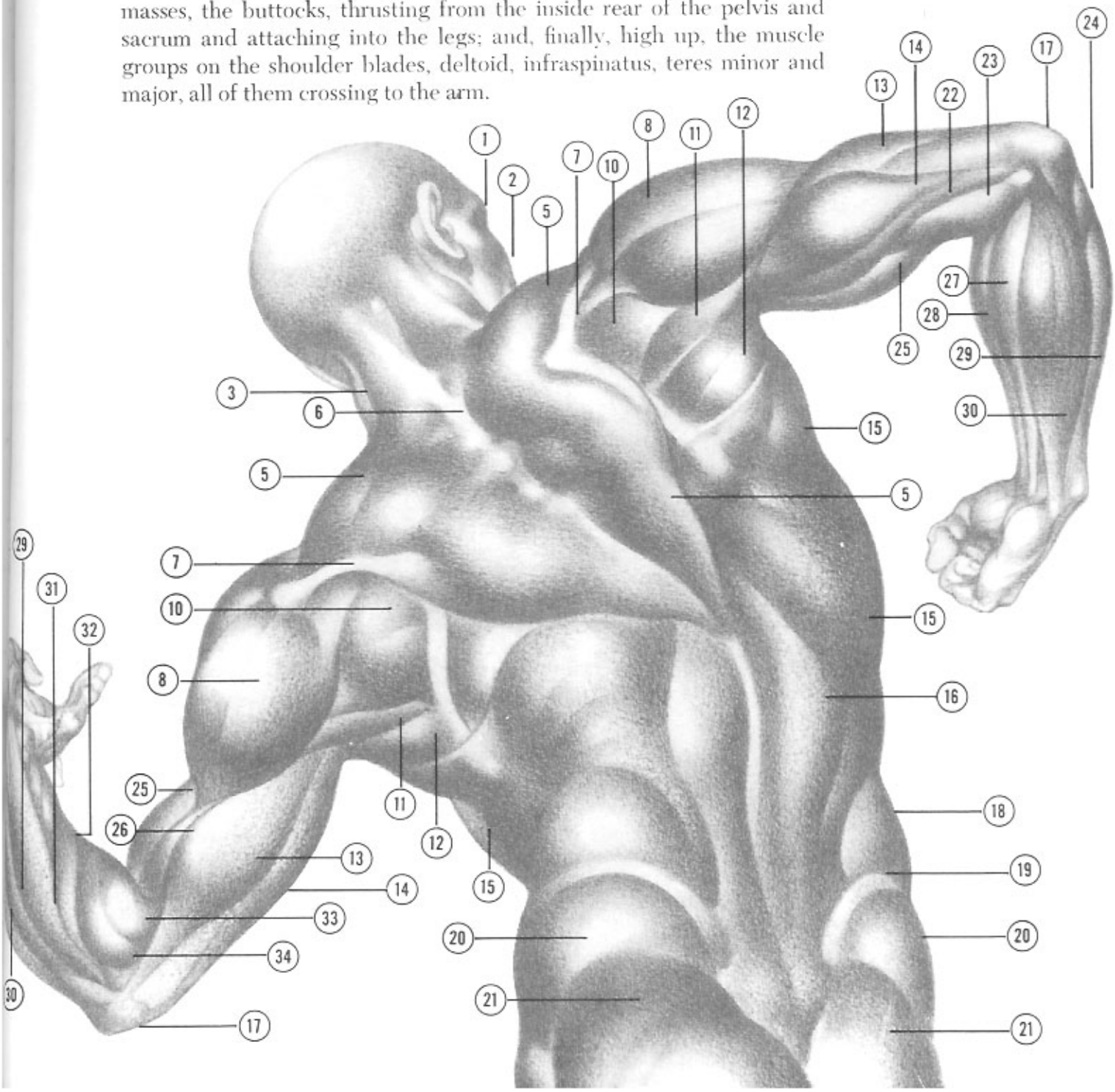
1. SPLENIUS CAPITIS
2. STERNOMASTOID
3. TRAPEZIUS
4. DELTOID
5. LEVATOR SCAPULAE
6. OMOHYOID
7. CLAVICLE
8. BICEPS
9. STERNUM
10. TERES MAJOR
11. PECTORALIS MAJOR
12. LATISSIMUS DORSI
13. SERRATUS ANTERIOR
14. LINEA ALBA
15. RECTUS ABDOMINIS
16. UMBILICUS
17. EXTERNUS OBLIQUE
18. INGUINAL LIGAMENT

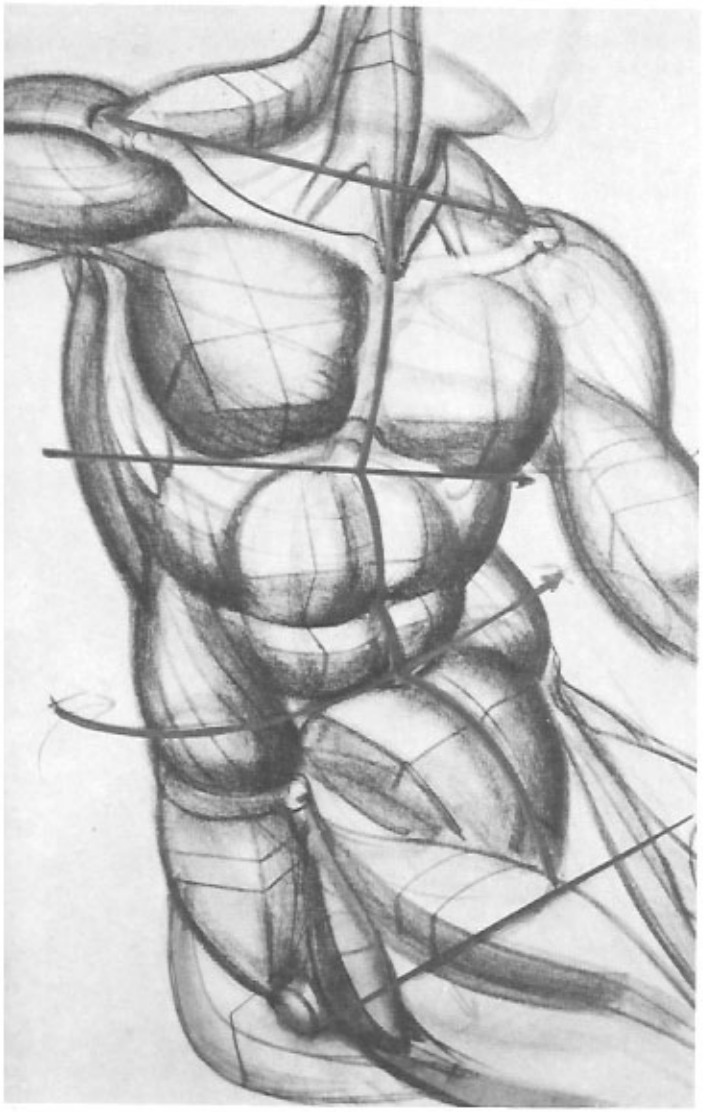

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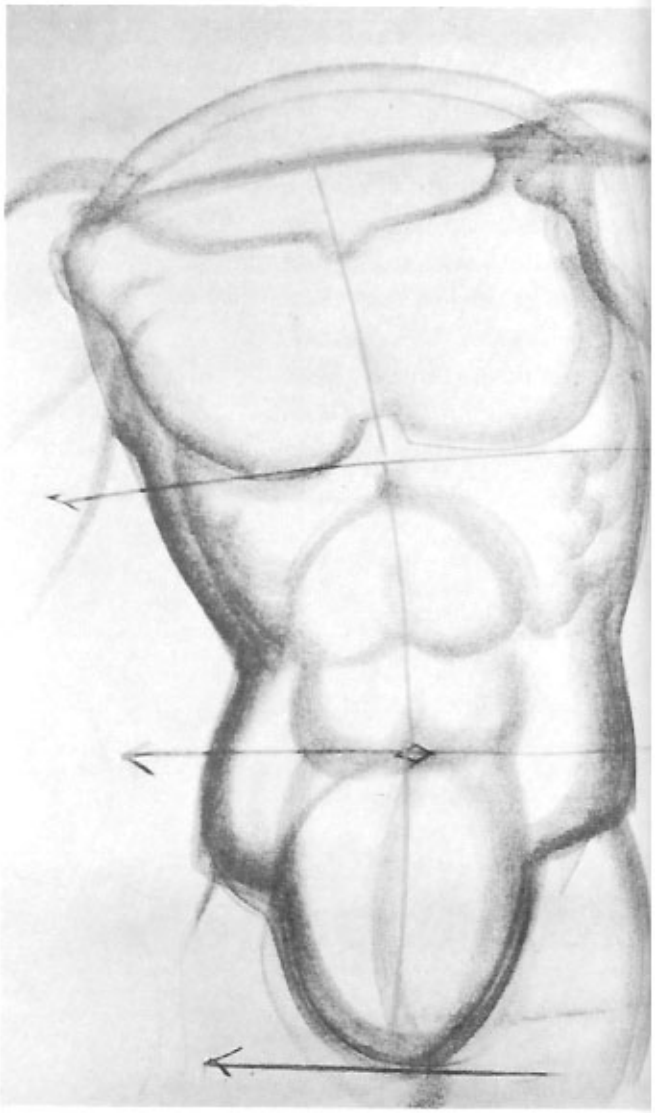


1. SUPERCILIARY ARCH
2. ZYGOMATIC BONE
3. STERNOMASTOID
4. MASSETER
5. TRAPEZIUS
6. SEVENTH CERVICAL VERTEBRA
7. ACROMION
8. DELTOID
9. TRAPEZIUS
10. INFRASPINATUS
11. TERES MINOR
12. TERES MAJOR
13. TRICEPS – LATERAL HEAD
14. TRICEPS – LONG HEAD
15. LATISSIMUS DORSI
16. SACROSPINALIS
17. OLECRANON
18. EXTERNUS OBLIQUE
19. ILIAC CREST
20. GLUTEUS MEDIUS
21. GLUTEUS MAXIMUS
22. TRICEPS – MEDIAL HEAD
23. BRACHIALIS
24. ANCONEUS
25. BICEPS
26. BRACHIALIS
27. PALMARIS LONGUS
28. FLEXOR CARPI RADIALIS
29. EXTENSOR CARPI ULNARIS
30. FLEXOR CARPI ULNARIS
31. EXTENSOR DIGITORUM
32. EXTENSOR CARPI RADIALIS BREVIS
33. BRACHIORADIALIS
34. EXTENSOR CARPI RADIALIS LONGUS

The back torso comprises fourteen large muscle groups, seven on each side of the spine. These are: the kite-shaped trapezius high up on the back, connecting skull and shoulder blades and tapering into the spine; the latissimus dorsi or sling muscles, attaching high under the arm and descending to the back of the pelvis; the externus obliques, continuing from the front and anchoring on the arch of the pelvis; the sacro-spinalis columns, the erectors of the spine, centrally located in the lower middle of the back; the gluteus medius masses, buttressing the inside curves of the hip arches at the sides; the gluteus maximus masses, the buttocks, thrusting from the inside rear of the pelvis and sacrum and attaching into the legs; and, finally, high up, the muscle groups on the shoulder blades, deltoid, infraspinatus, teres minor and major, all of them crossing to the arm.







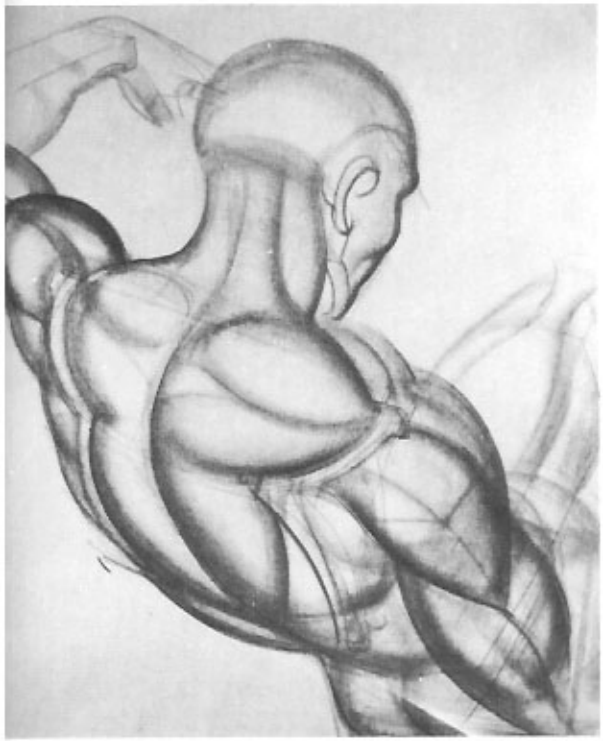
4. MEASUREMENTS. The torso, front view, measures over-all three heads in length, while the back torso measures three and a half heads in length. The front measurements divide thus: from a line drawn across the collar bones to the base of the pectorals, one head length; from the pectoral line to the umbilicus or navel, a second head length; from the navel to the pubic arch, a third head length. The lower visceral mass of the abdominis frontally can be seen as a head shape within the pelvic basin.

The measurements of the back torso show these divisions: from a line drawn across the extreme widths of the shoulder blades to the base points of the blades, one head length; from the points to the mid-position of the externus oblique muscles, a second head length (it will be noted that this line is drawn from across the navel position, front); from this mid-position to the end of the spine or coccyx bone (the pubic arch rear), a third head length; and from the coccyx to the base of the buttocks, one-half head length.



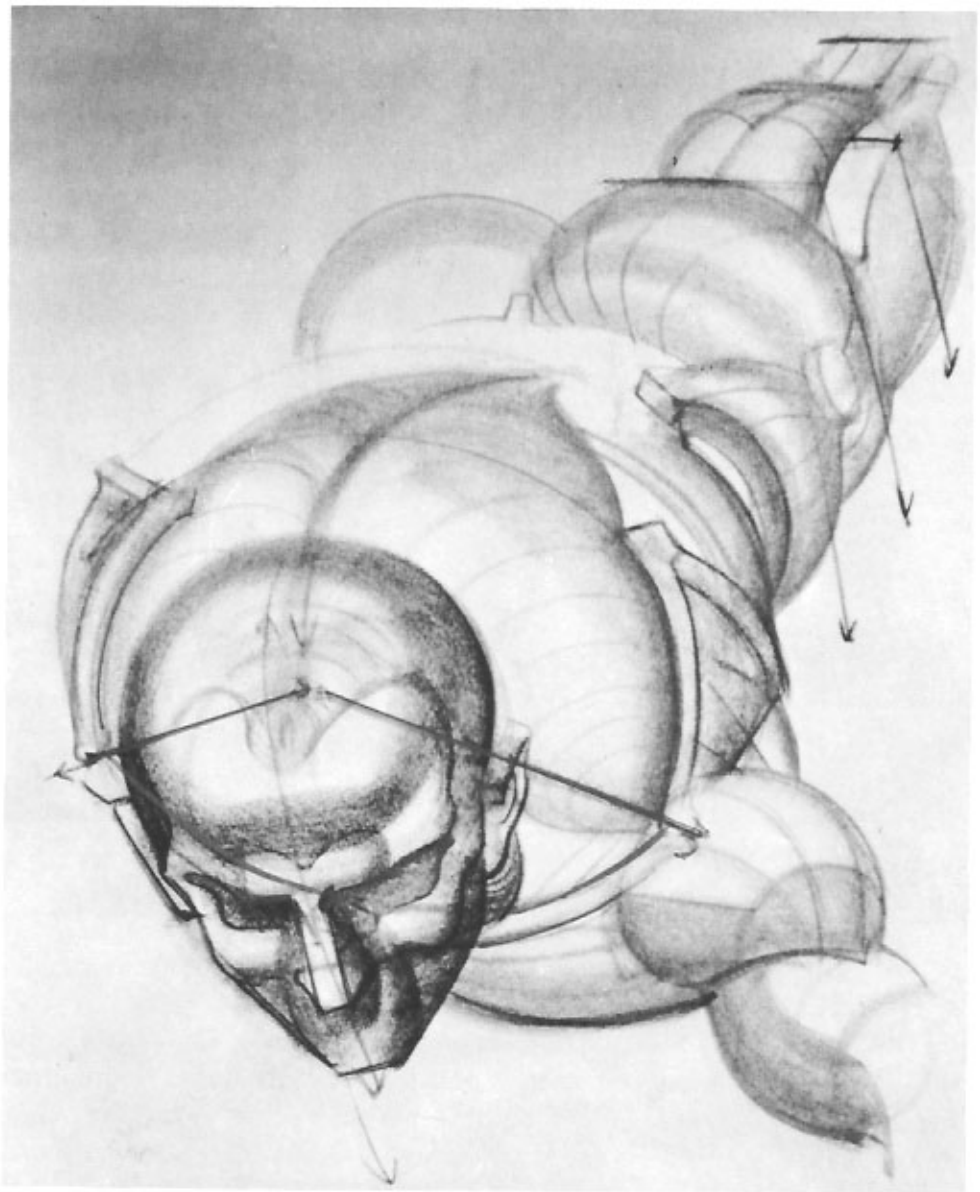




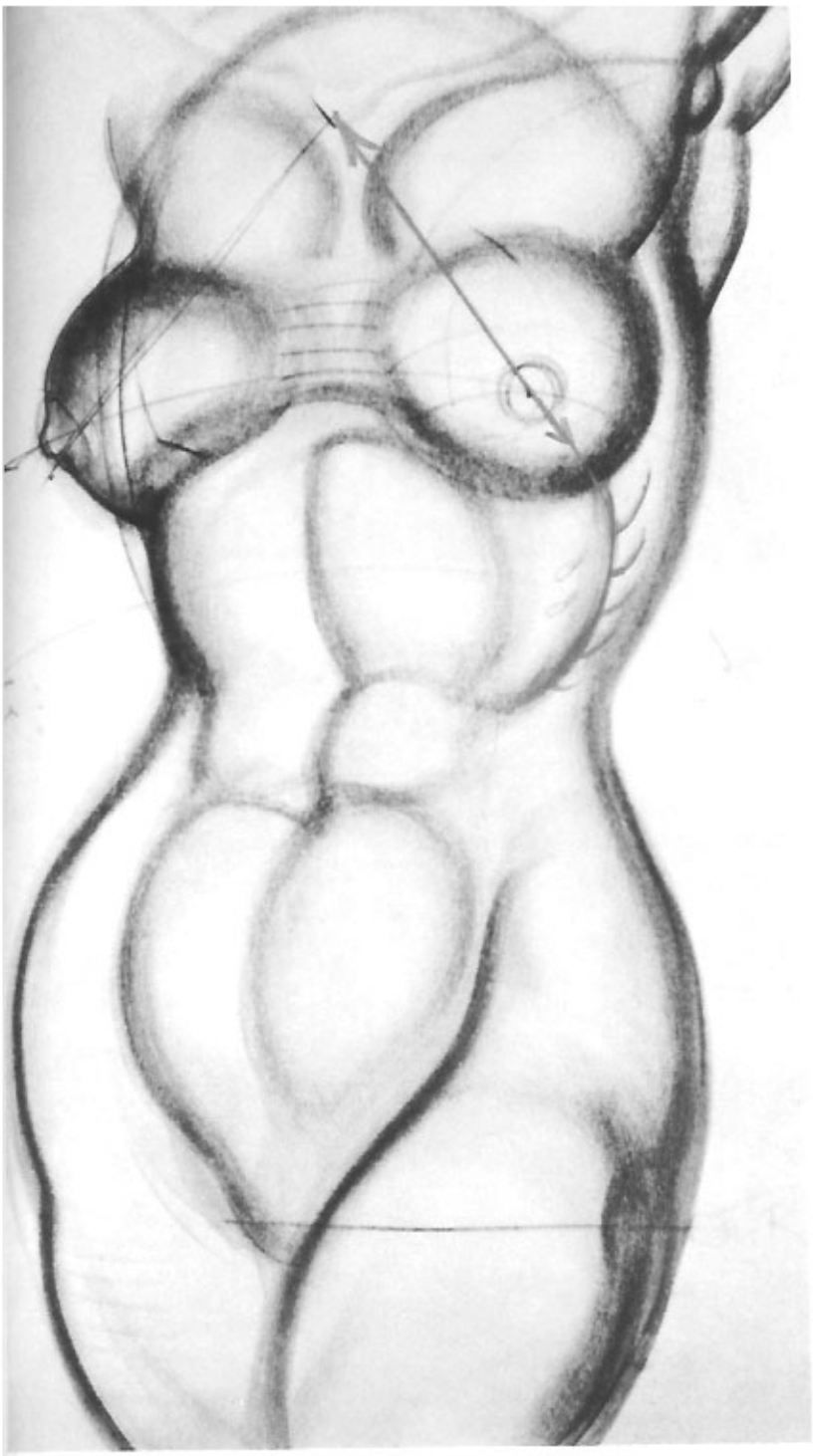


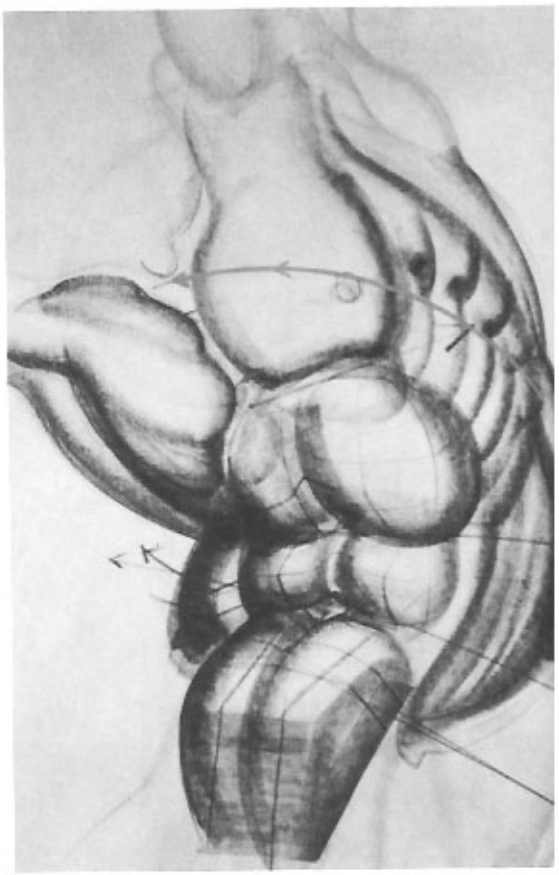


5. POINTS TO REMEMBER IN DRAWING. The entire group of back muscles can be easily positioned with the "M" diagram of the back. The large "M" should be placed on the back rib cage at a height just lower than the shoulders and drawn down to the shoulder blade points. The arms of the "M" identify the edges of the shoulder blades. The blades can thus be affixed. The inside of the "M," the deep "V," is the tapered line of trapezius. Thus, the mass of trapezius above easily falls into place. The side latissimus masses can now be laid in under the arms of the "M" to the inner "V." The middle lower groups, erectors and obliques, descend and widen from under the point of the inner "V." Location and placement of muscle masses with this device will produce facility in the drawing of foreshortened or extreme views of the back in body movement.

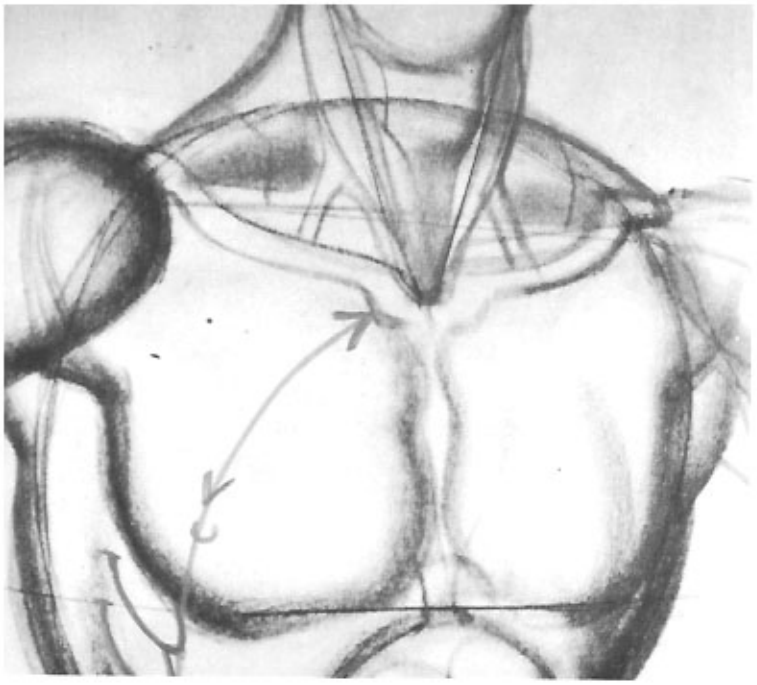


The front torso at the shoulders and collar bones has the appearance of a sloping diamond-shape. In difficult views, across or down, this shape enables the artist to locate the neck tunneling in and to place the origin of arms across the shoulders.

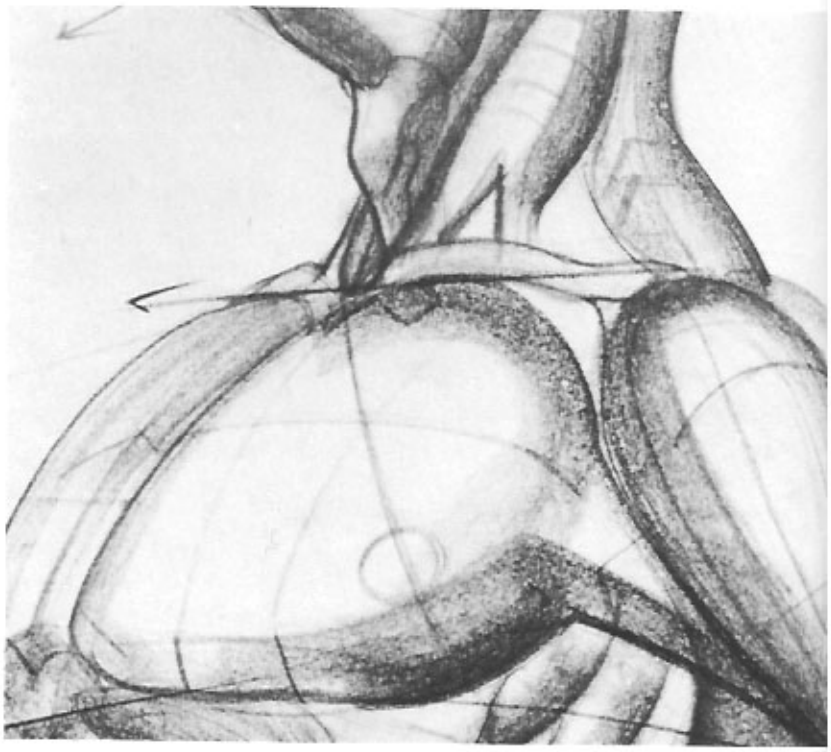


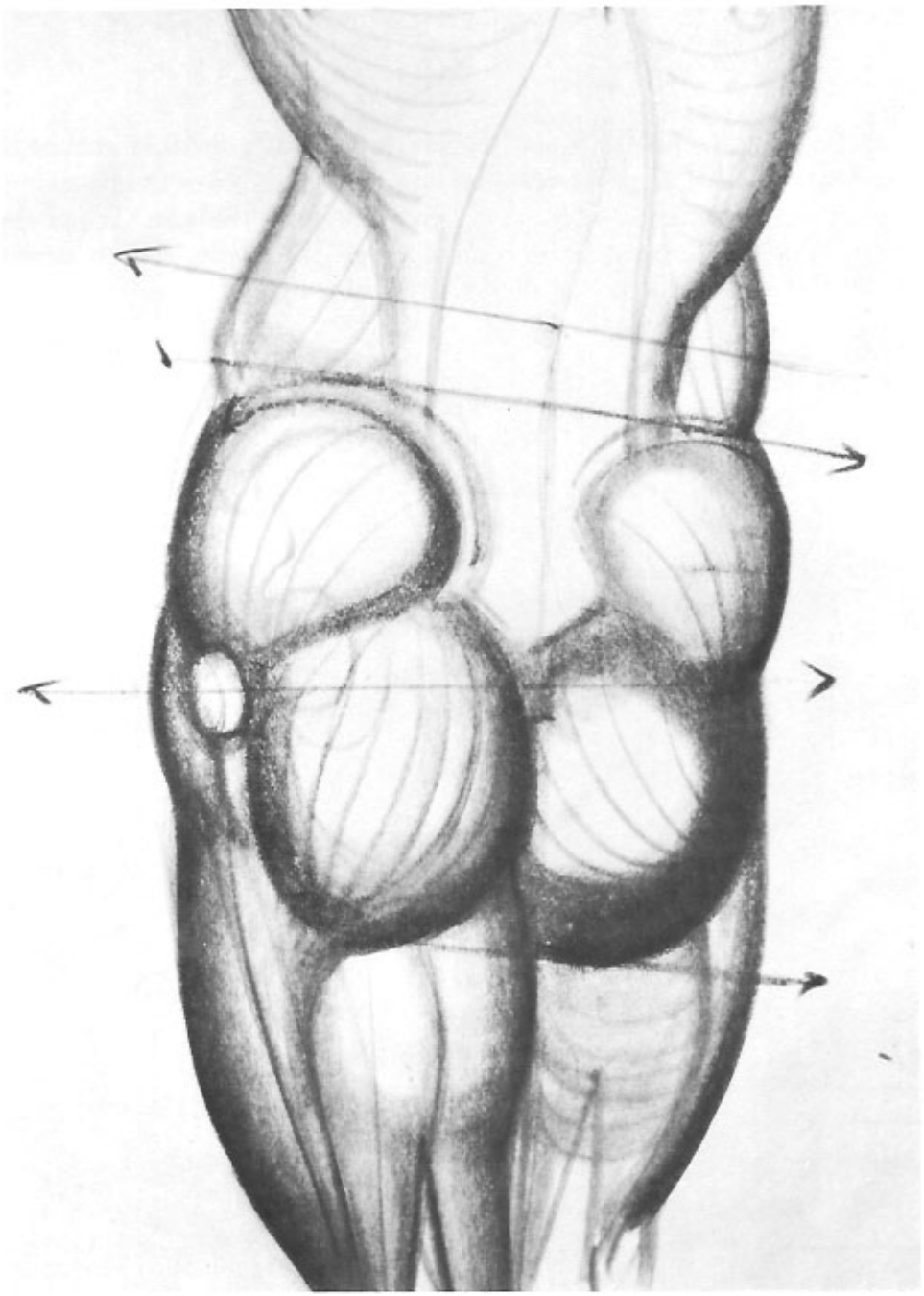


To place the serratus muscles on the rib cage correctly, a line drawn from the pit of the neck through the nipple will cross the pectorals and rib cage at a curving 45-degree angle to the base of the ribs. This line, below the pectorals, holds the five serratus slots in place.



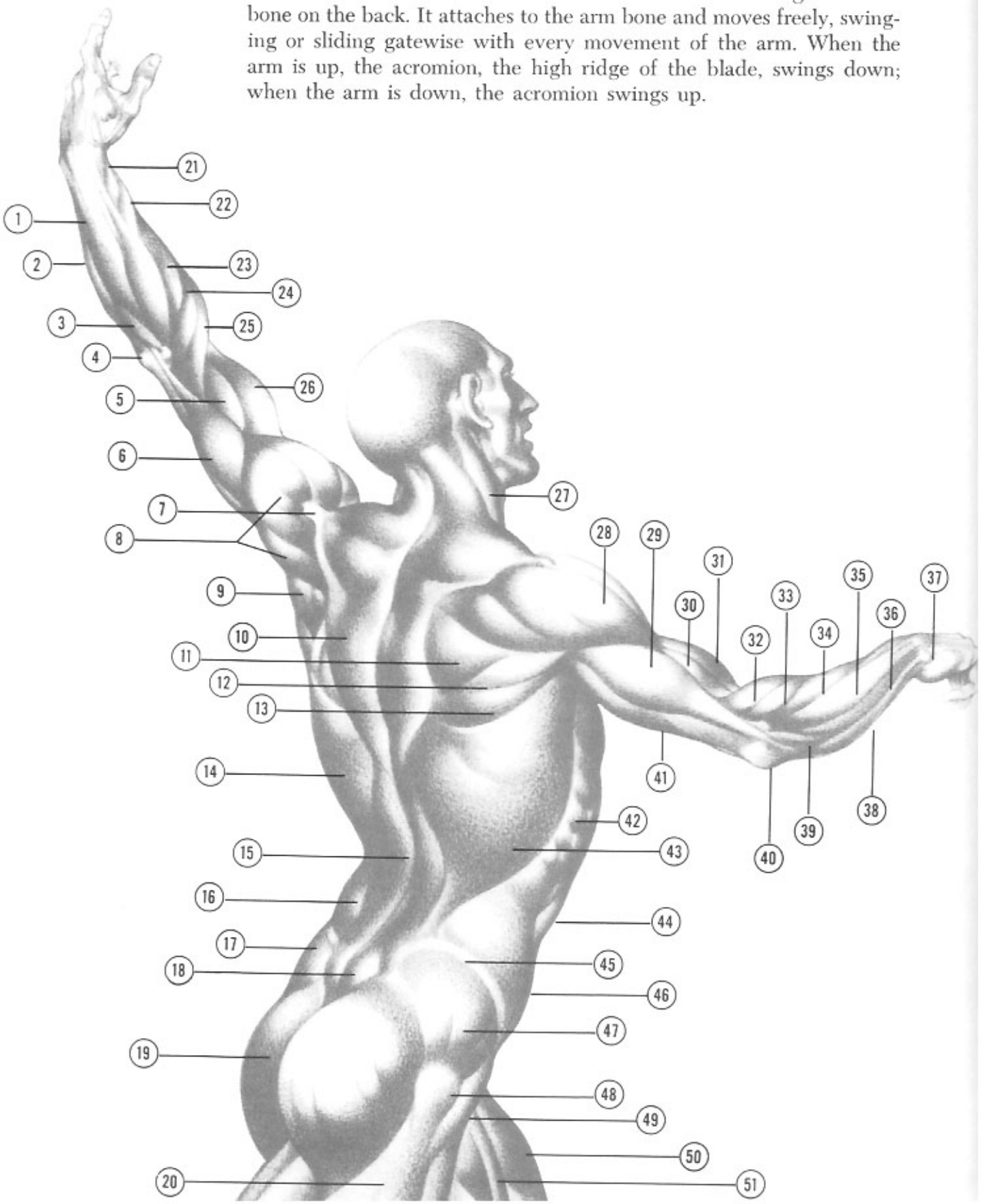
The collar bones, seen together, have the appearance of a coat hanger turned upside down. Taken separately, the form of each clavicle presents an elongated "S" line of movement from *any* viewing position.





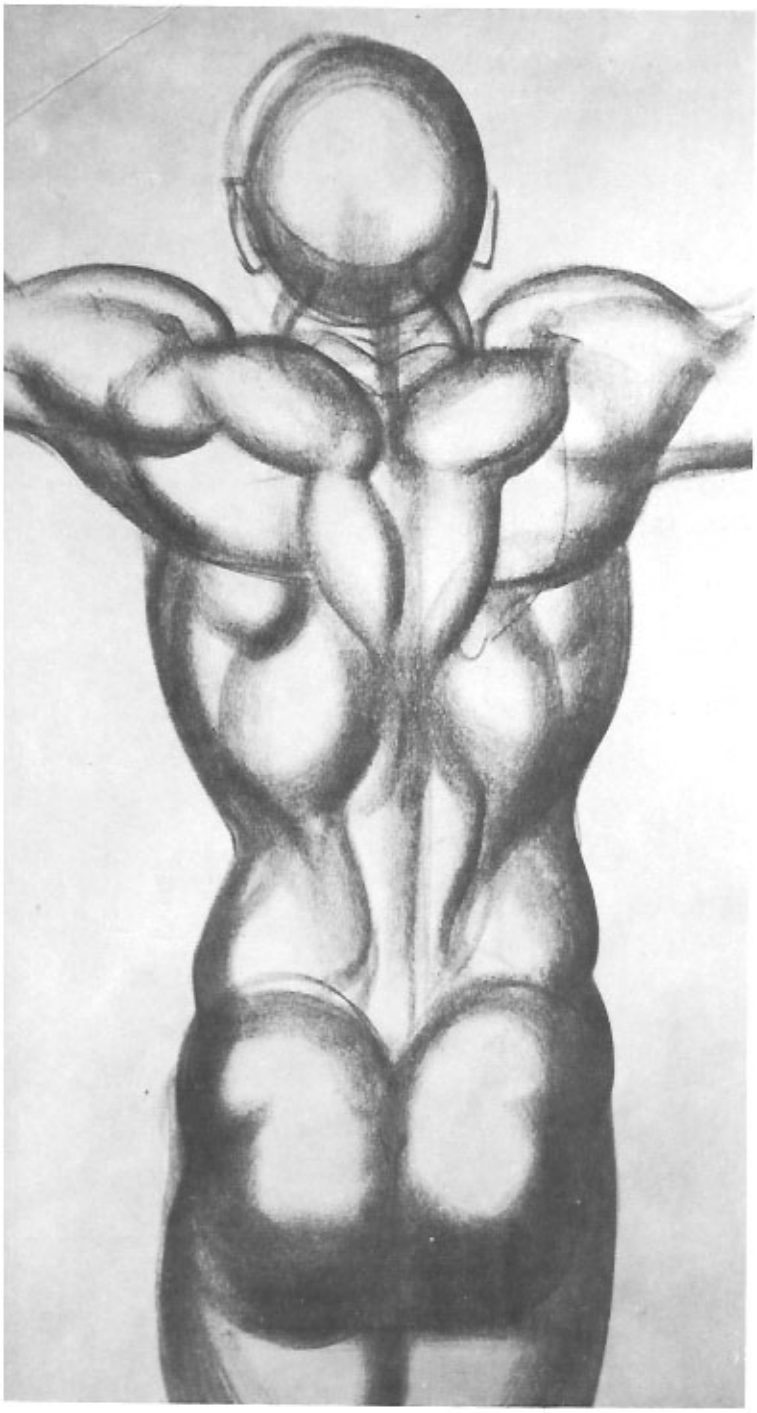
The pelvic mass, rear view, has a distinct *butterfly shape* in drawing. The two upper wings are the gluteus medius masses under the iliac or pelvic curves. The lower wings are the gluteus maximus or buttock masses. In the separations of the upper and lower wings, the great trochanter protrusions of the leg bones appear.

The shoulder blades should be understood as a floating anchor of bone on the back. It attaches to the arm bone and moves freely, swinging or sliding gatewise with every movement of the arm. When the arm is up, the acromion, the high ridge of the blade, swings down; when the arm is down, the acromion swings up.





1. EXTENSOR DIGITORUM
2. EXTENSOR CARPI ULNARIS
3. ANCONEUS
4. OLECRANON
5. BRACHIALIS
6. TRICEPS
7. ACROMION
8. DELTOID
9. INFRASPINATUS
10. TRAPEZIUS
11. INFRASPINATUS
12. TERES MINOR
13. TERES MAJOR
14. LATISSIMUS DORSI
15. SACROSPINALIS
16. EXTERNUS OBLIQUE
17. GLUTEUS MEDIUS
18. SACRUM
19. GLUTEUS MAXIMUS
20. VASTUS EXTERNUS
21. EXTENSOR POLLICIS BREVIS
22. ABDUCTOR POLLICIS LONGUS
23. EXTENSOR CARPI RADIALIS BREVIS
24. EXTENSOR CARPI RADIALIS LONGUS
25. BRACHIORADIALIS
26. BICEPS
27. STERNOMASTOID
28. DELTOID
29. TRICEPS – LATERAL HEAD
30. BRACHIALIS
31. BICEPS
32. BRACHIORADIALIS
33. EXTENSOR CARPI RADIALIS LONGUS
34. EXTENSOR CARPI RADIALIS BREVIS
35. EXTENSOR DIGITORUM
36. EXTENSOR CARPI ULNARIS
37. ULNAR HEAD
38. FLEXOR CARPI ULNARIS
39. ANCONEUS
40. OLECRANON
41. TRICEPS – LONG HEAD
42. SERRATUS ANTERIOR
43. LATISSIMUS DORSI
44. RECTUS ABDOMINIS
45. ILIAC CREST
46. EXTERNUS OBLIQUE
47. GLUTEUS MEDIUS
48. GREAT TROCHANTER
49. TENSOR FASCIAE LATAE
50. RECTUS FEMORIS
51. SARTORIUS

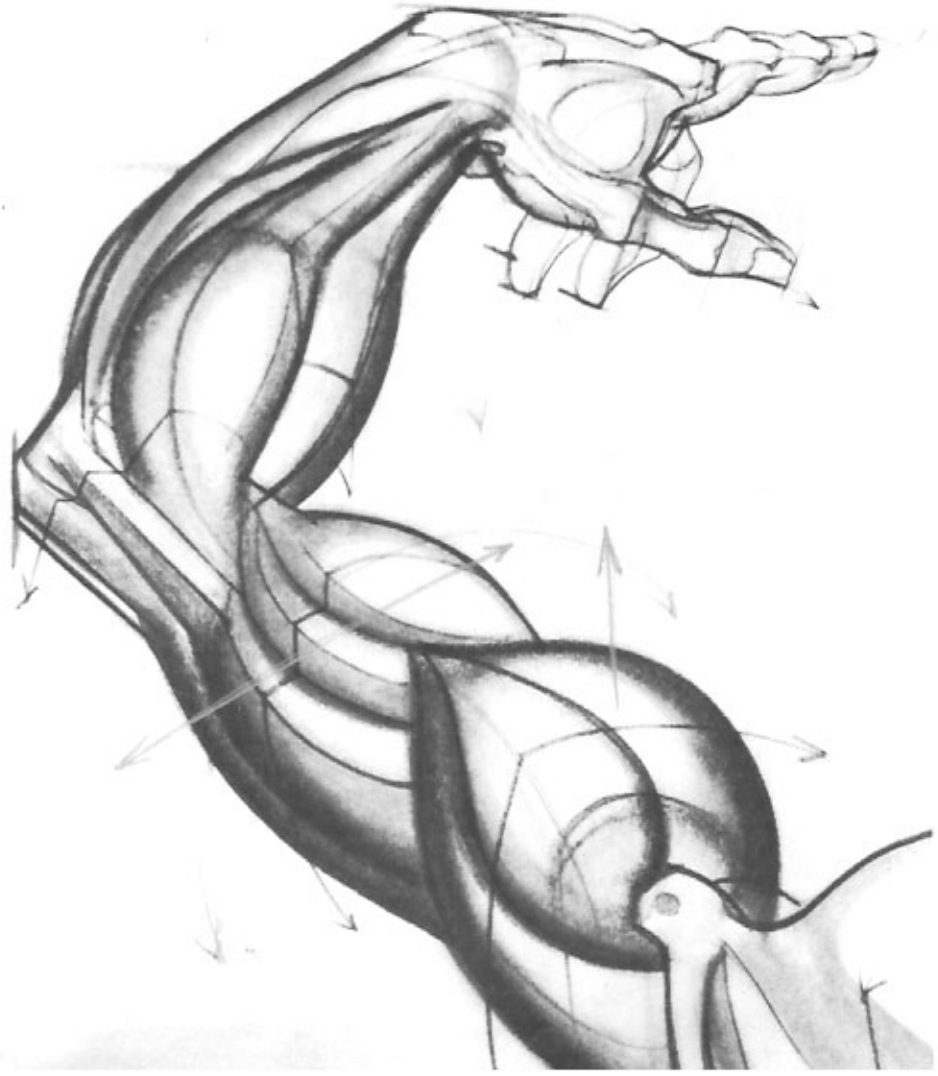




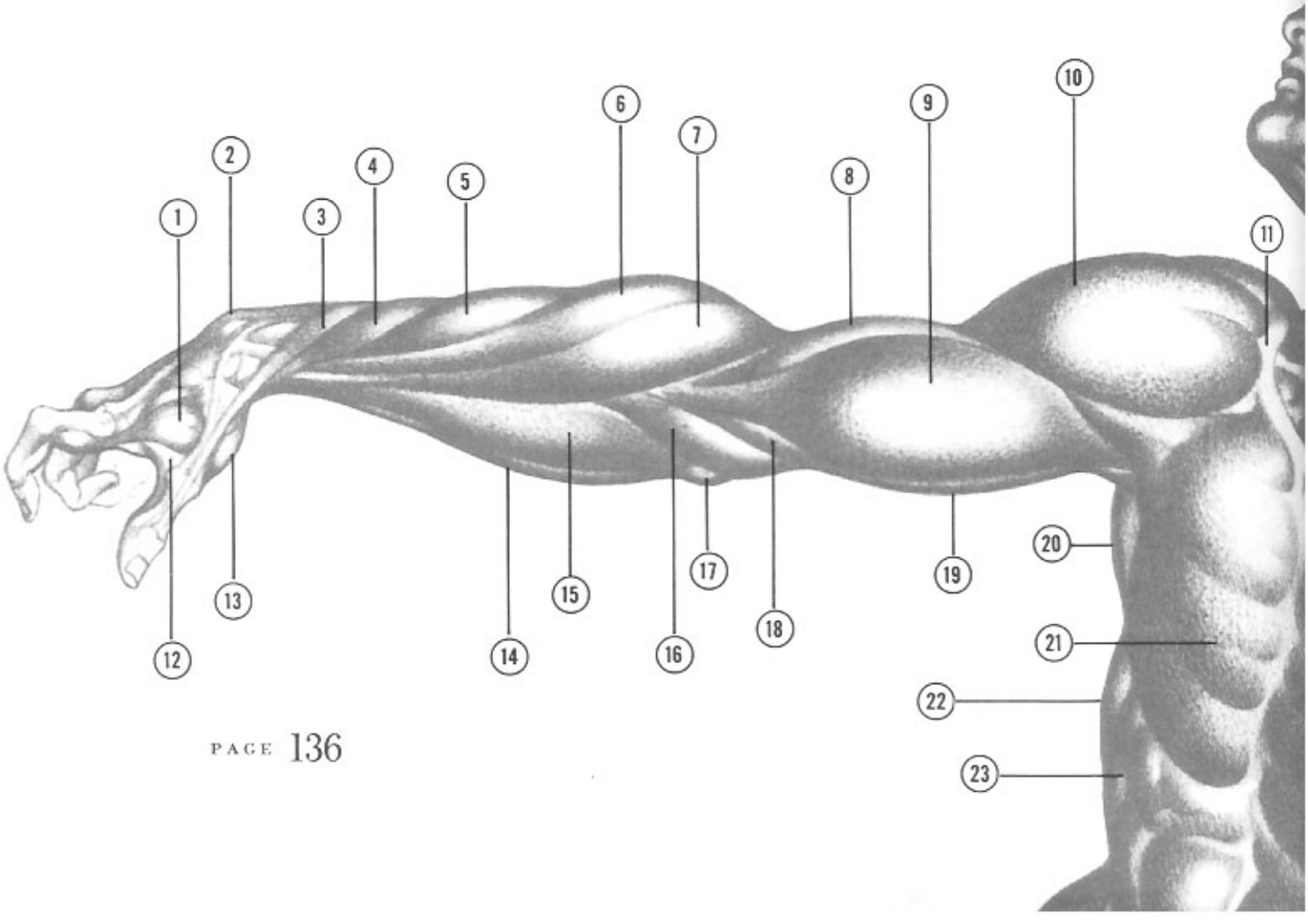
Note well: the entire muscle mass of upper torso around the body has one major function — to move the arms. The mid-axial mass, front and rear, bends, twists or stabilizes the two torso masses. The lower torso mass, below the pelvic girdle, activates the legs.

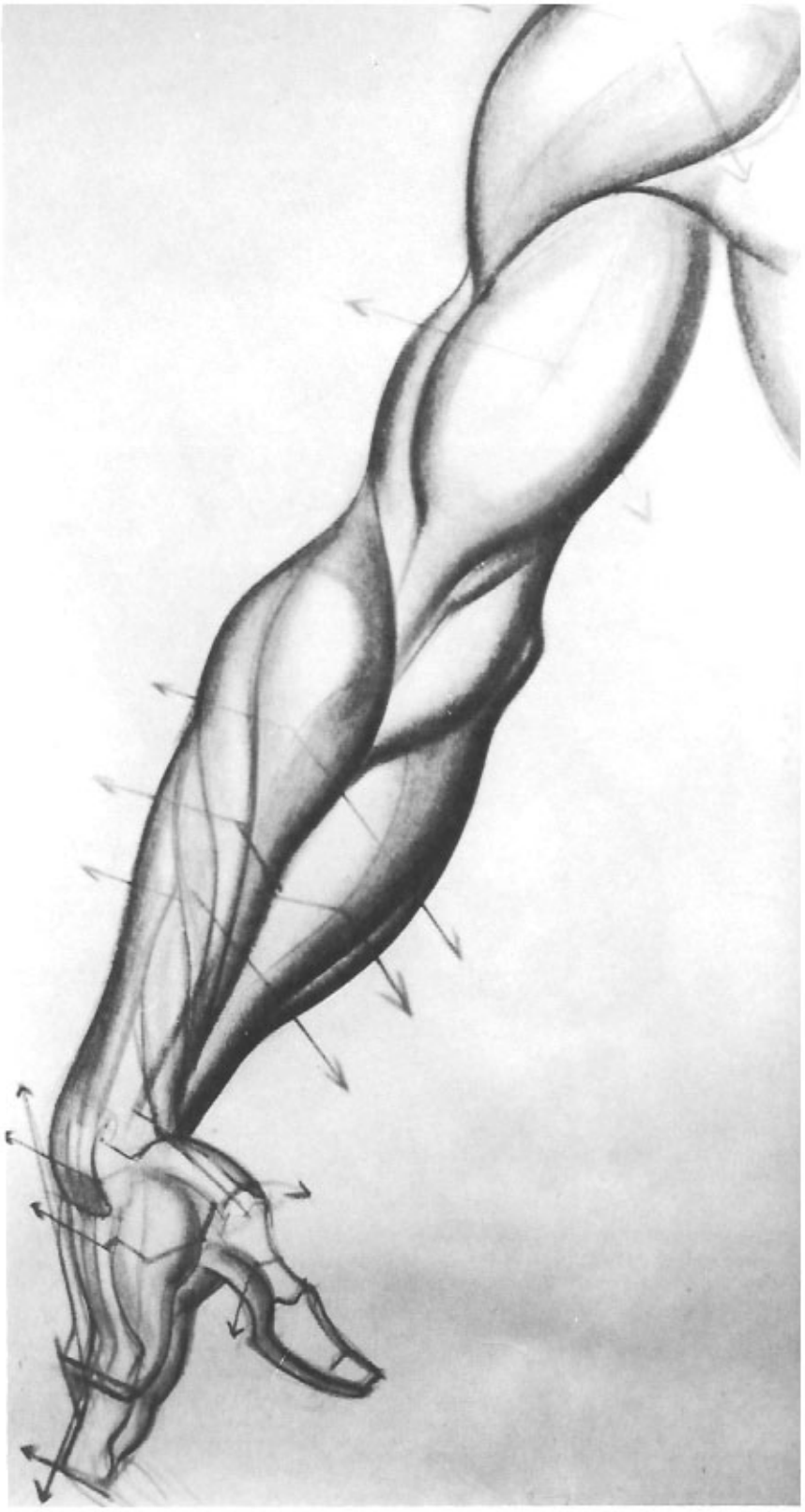
THE ARM

1. THE UPPER ARM. The upper arm is a rather flat, elongated tapered form from shoulder to elbow, surmounted by a broad high mass of muscle. The member consists of three major muscle masses: the biceps frontally, with brachialis as a component for bending the lower member; the triceps to the rear for straightening it; and the deltoid to the side high up, the shoulder mass, for raising the entire arm. The thrust of shapes on the upper arm presents a constant opposition: the biceps and triceps move frontward and backward, while the deltoid, higher up, thrusts sideward and upward. The deltoid may be compared to the gluteus masses of the lower torso. Each group elevates its lower member. The deltoid raises the arm front, side, and back; the glutei raise the leg side and rear only.



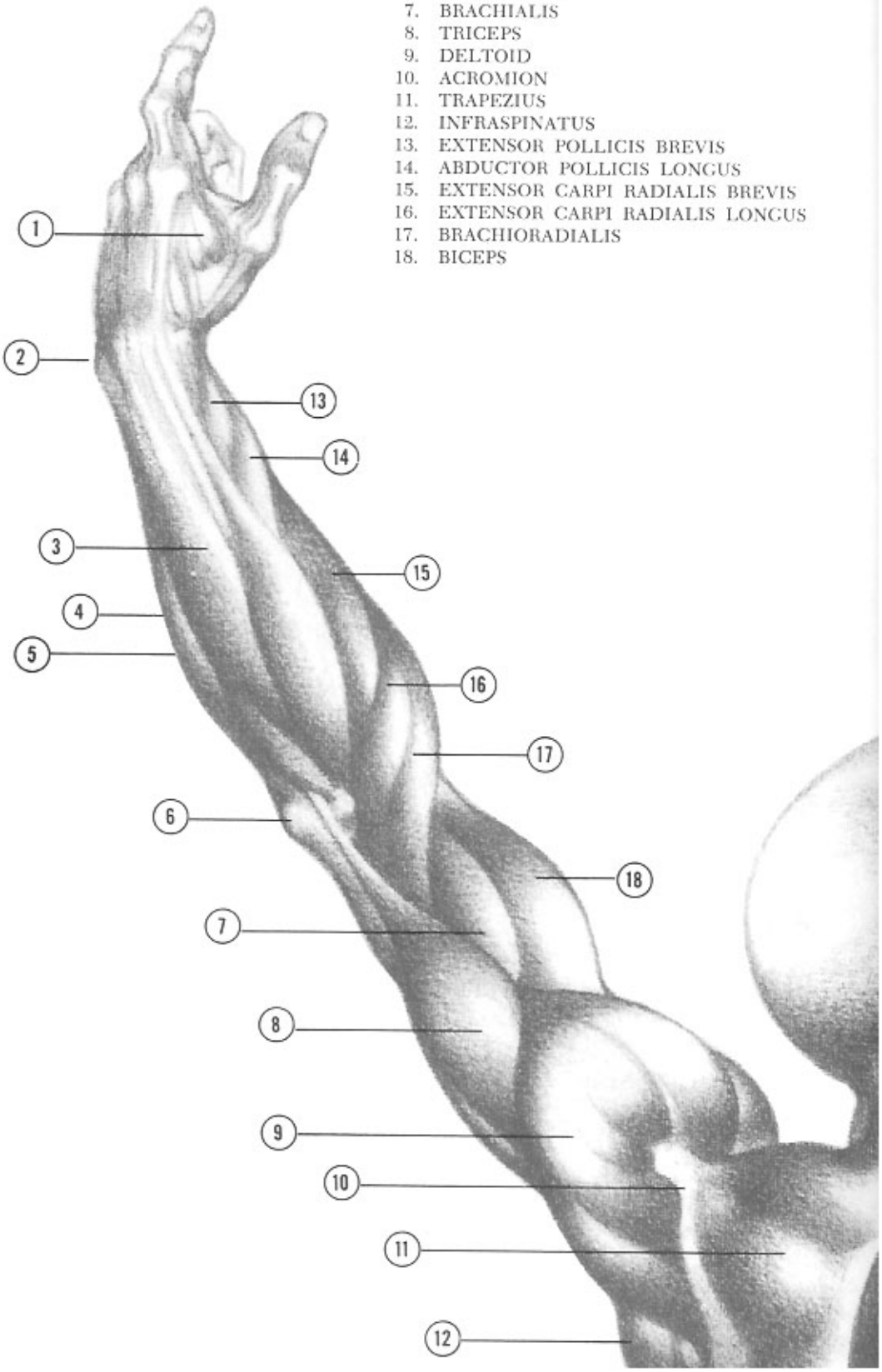
2. THE LOWER ARM. The lower arm presents a roundly developed tapered mass from elbow to the flattened form of the wrist. The masses of the forearm lie opposed to the upper arm masses, moving generally from outside to inside against the torso. The forearm consists of three important muscle groups: the under forearm group, the flexors, for bending the palm and clenching the fingers; the outer forearm group, the extensors, for straightening the palm and opening the fingers; and the brachioradialis group, the supinators, attached to the upper elbow on the outside arm, and descending the length of forearm to the inside wrist, for rotating the palm of the hand outward. A fourth smaller muscle, the pronator, originates on the inner elbow projection of the humerus and crosses to the forearm to perform rotation of the palm inward to the body.



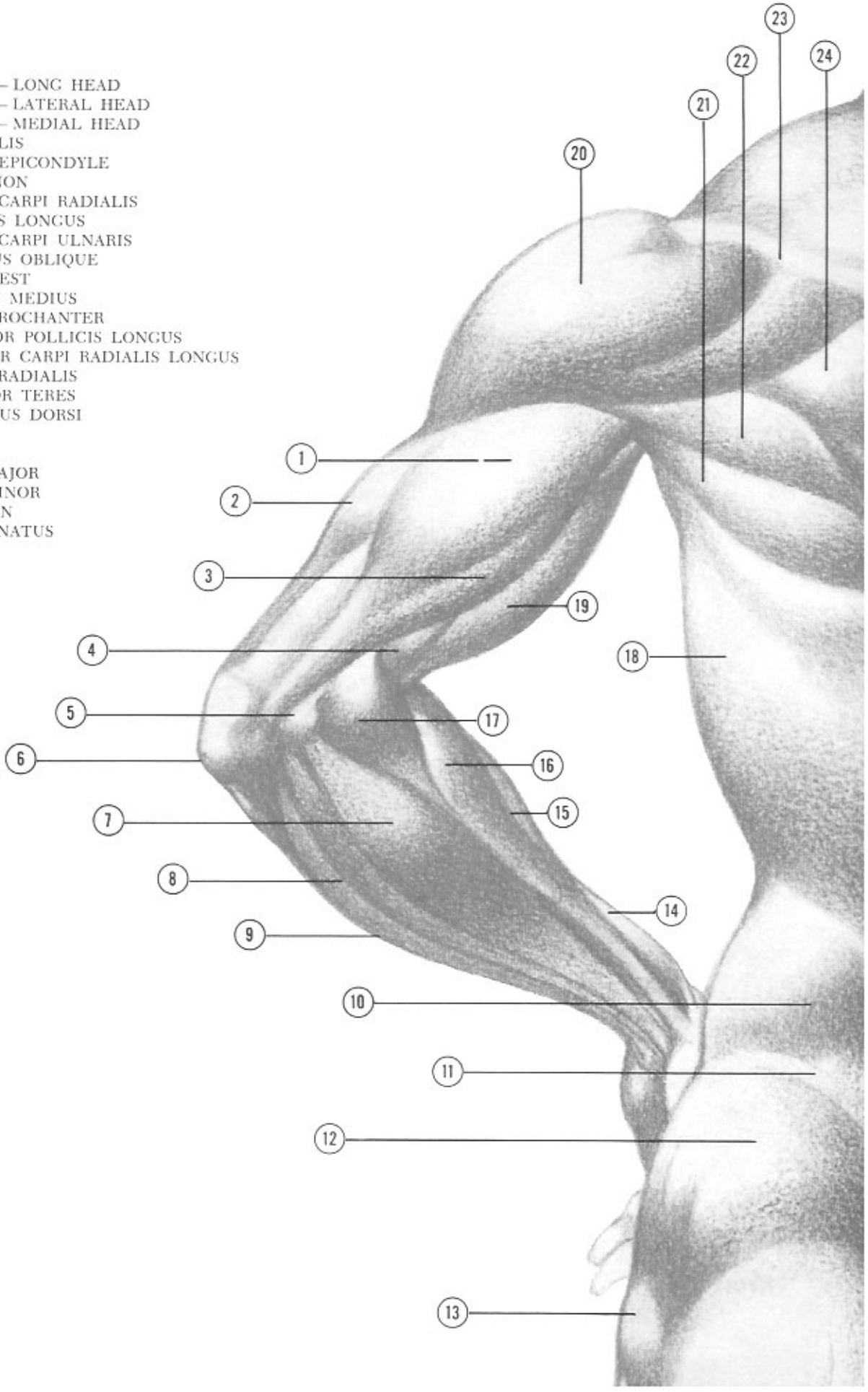


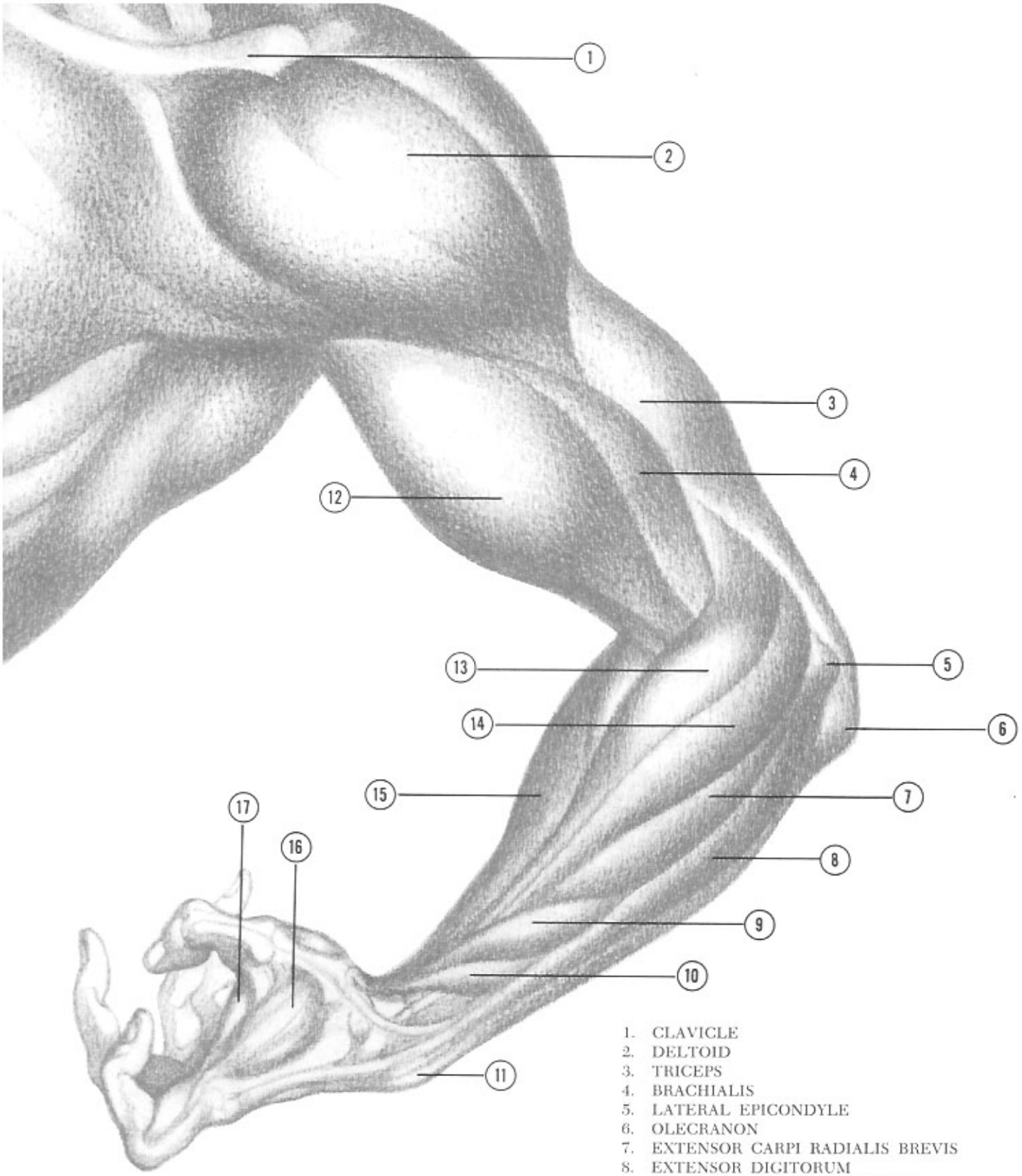
1. INTEROSSEUS
2. LUNATE PROMINENCE
3. EXTENSOR POLLICIS BREVIS
4. ABDUCTOR POLLICIS LONGUS
5. EXTENSOR CARPI RADIALIS BREVIS
6. EXTENSOR CARPI RADIALIS LONGUS
7. BRACHIORADIALIS
8. BRACHIALIS
9. BICEPS
10. DELTOID
11. CLAVICLE
12. ADDUCTOR POLLICIS
13. ABDUCTOR POLLICIS BREVIS
14. PALMARIS LONGUS
15. FLEXOR CARPI RADIALIS
16. PRONATOR TERES
17. MEDIAL EPICONDYLE
18. BRACHIALIS
19. TRICEPS – MEDIAL HEAD
20. TERES MAJOR
21. PECTORALIS MAJOR
22. LATISSIMUS DORSI
23. SERRATUS ANTERIOR

1. INTEROSSEUS
2. ULNAR HEAD
3. EXTENSOR DIGITORUM
4. EXTENSOR CARPI ULNARIS
5. FLEXOR CARPI ULNARIS
6. OLECRANON
7. BRACHIALIS
8. TRICEPS
9. DELTOID
10. ACROMION
11. TRAPEZIUS
12. INFRASPINATUS
13. EXTENSOR POLLICIS BREVIS
14. ABDUCTOR POLLICIS LONGUS
15. EXTENSOR CARPI RADIALIS BREVIS
16. EXTENSOR CARPI RADIALIS LONGUS
17. BRACHIORADIALIS
18. BICEPS



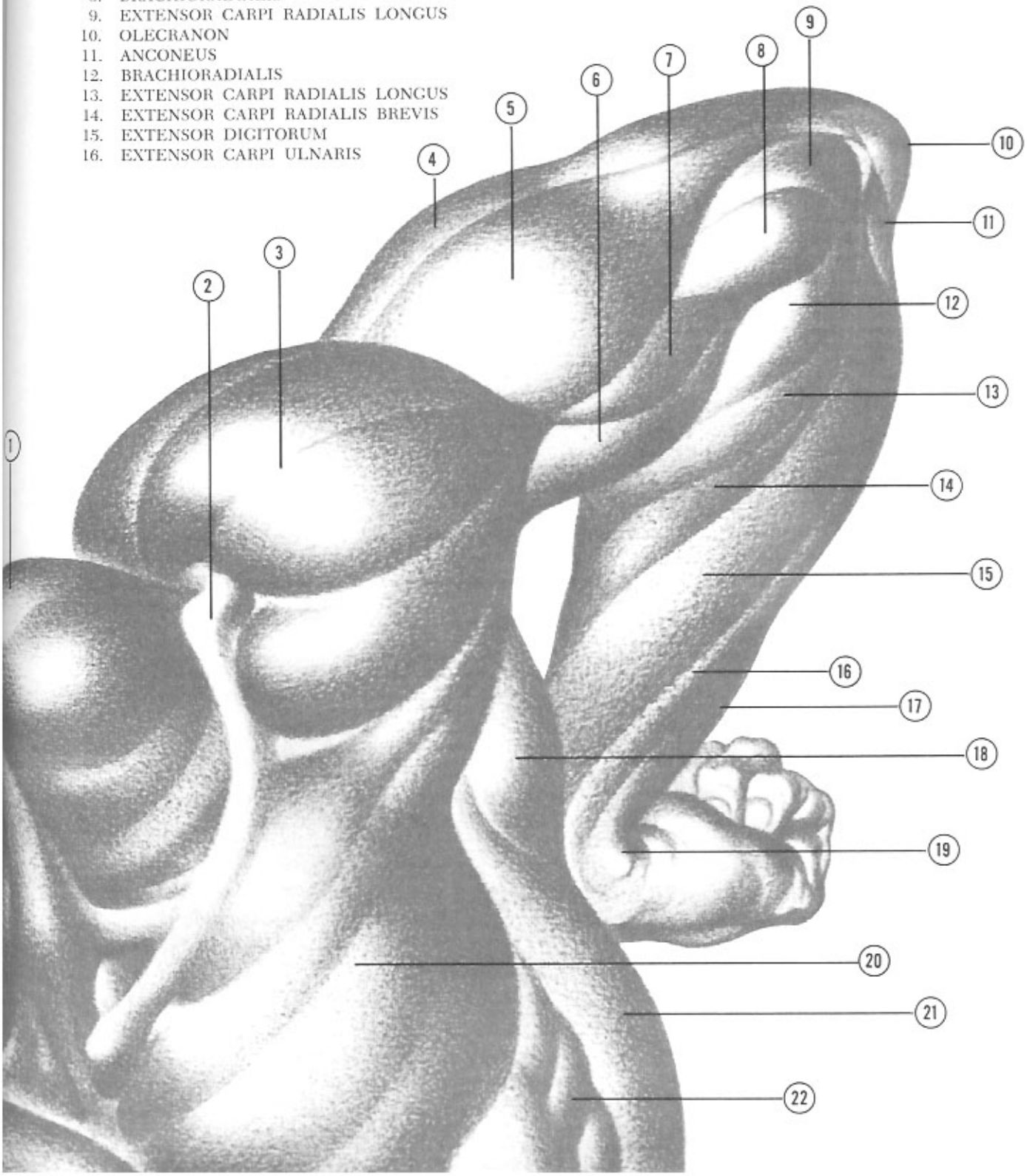
1. TRICEPS – LONG HEAD
2. TRICEPS – LATERAL HEAD
3. TRICEPS – MEDIAL HEAD
4. BRACHIALIS
5. MEDIAL EPICONDYLE
6. OLECRANON
7. FLEXOR CARPI RADIALIS
8. PALMARIS LONGUS
9. FLEXOR CARPI ULNARIS
10. EXTERNUS OBLIQUE
11. ILIAC CREST
12. GLUTEUS MEDIUS
13. GREAT TROCHANTER
14. ABDUCTOR POLLICIS LONGUS
15. EXTENSOR CARPI RADIALIS LONGUS
16. BRACHIORADIALIS
17. PRONATOR TERES
18. LATISSIMUS DORSI
19. BICEPS
20. DELTOID
21. TERES MAJOR
22. TERES MINOR
23. ACROMION
24. INFRASPINATUS

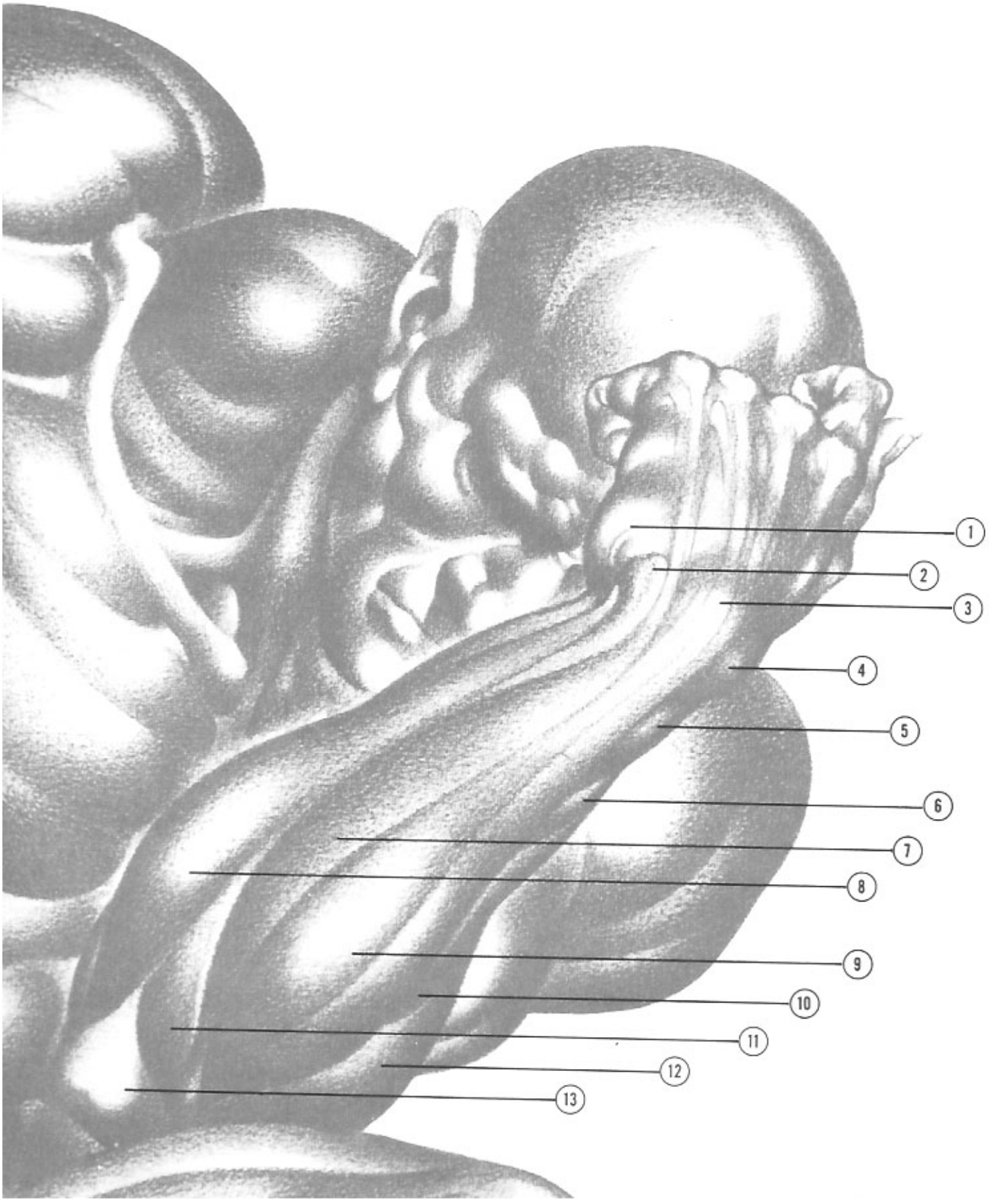


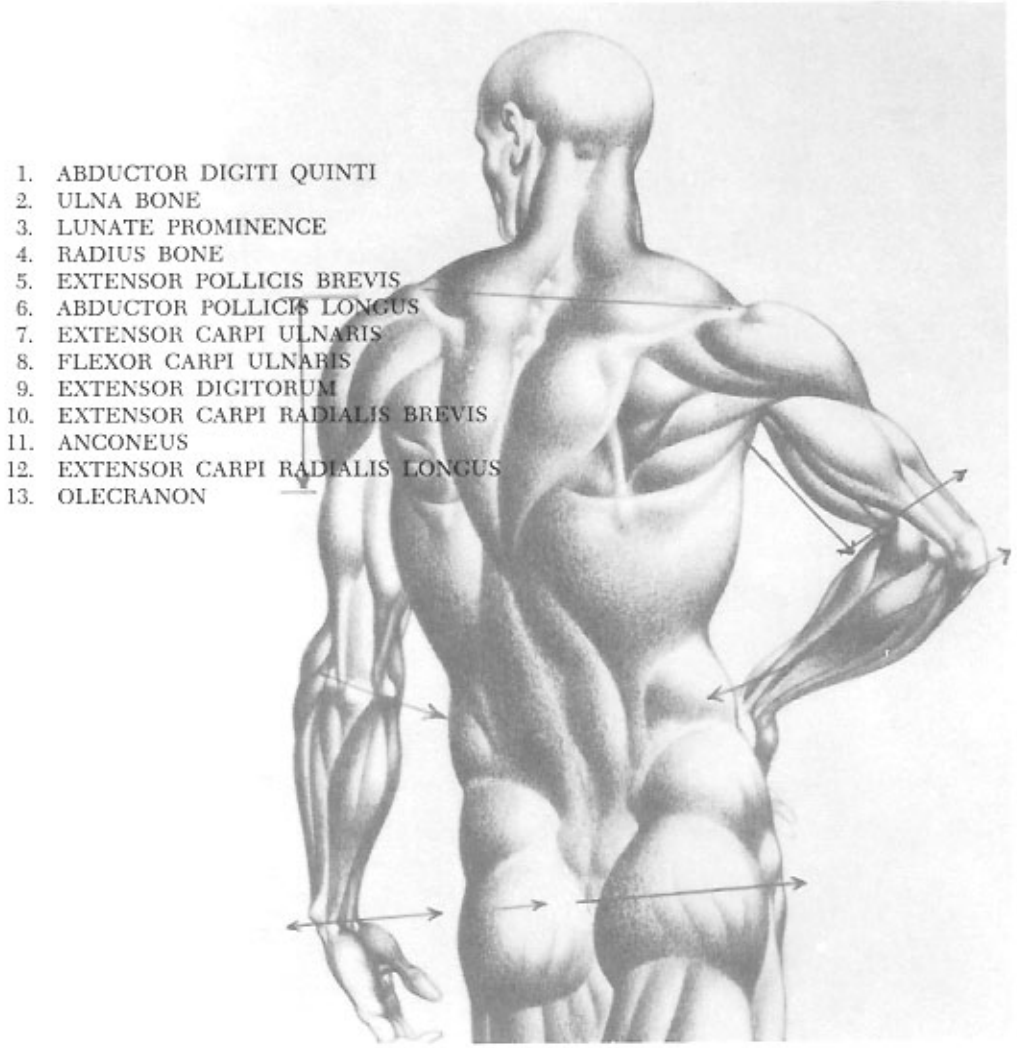


1. CLAVICLE
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3. TRICEPS
4. BRACHIALIS
5. LATERAL EPICONDYLE
6. OLECRANON
7. EXTENSOR CARPI RADIALIS BREVIS
8. EXTENSOR DIGITORUM
9. ABDUCTOR POLLICIS LONGUS
10. EXTENSOR POLLICIS BREVIS
11. LUNATE PROMINENCE
12. BICEPS
13. BRACHIORADIALIS
14. EXTENSOR CARPI RADIALIS LONGUS
15. FLEXOR CARPI RADIALIS
16. INTEROSSEUS
17. ADDUCTOR POLLICIS

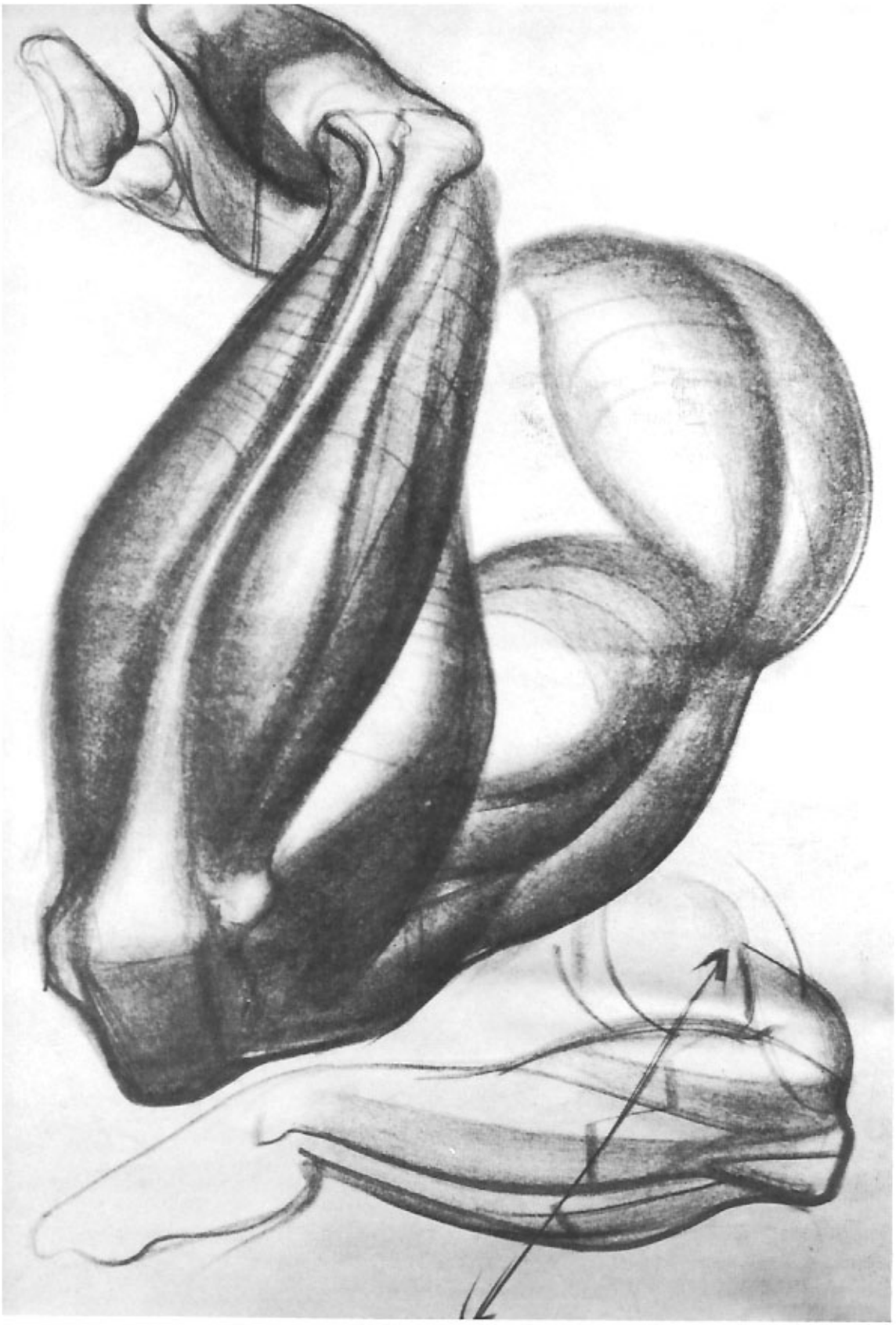
1. TRAPEZIUS
2. CLAVICLE
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4. TRICEPS – LONG HEAD
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6. BICEPS
7. BRACHIALIS
8. BRACHIORADIALIS
9. EXTENSOR CARPI RADIALIS LONGUS
10. OLECRANON
11. ANCONEUS
12. BRACHIORADIALIS
13. EXTENSOR CARPI RADIALIS LONGUS
14. EXTENSOR CARPI RADIALIS BREVIS
15. EXTENSOR DIGITORUM
16. EXTENSOR CARPI ULNARIS
17. FLEXOR CARPI ULNARIS
18. TERES MAJOR
19. ULNAR HEAD
20. PECTORALIS MAJOR
21. LATISSIMUS DORSI
22. SERRATUS ANTERIOR



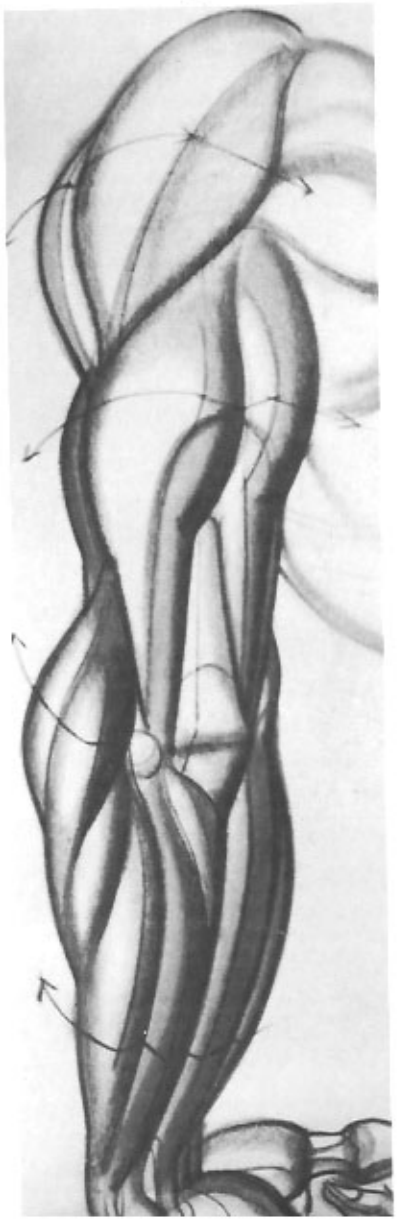

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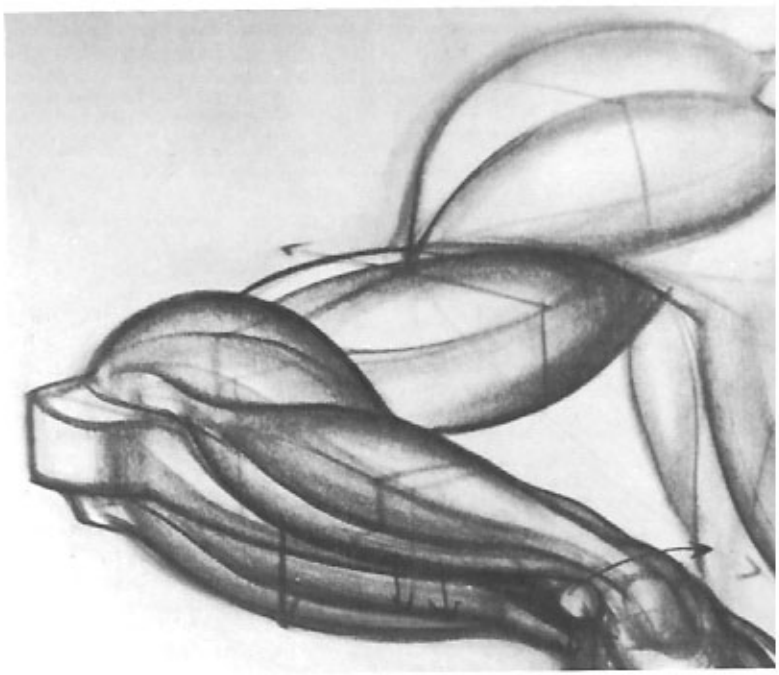


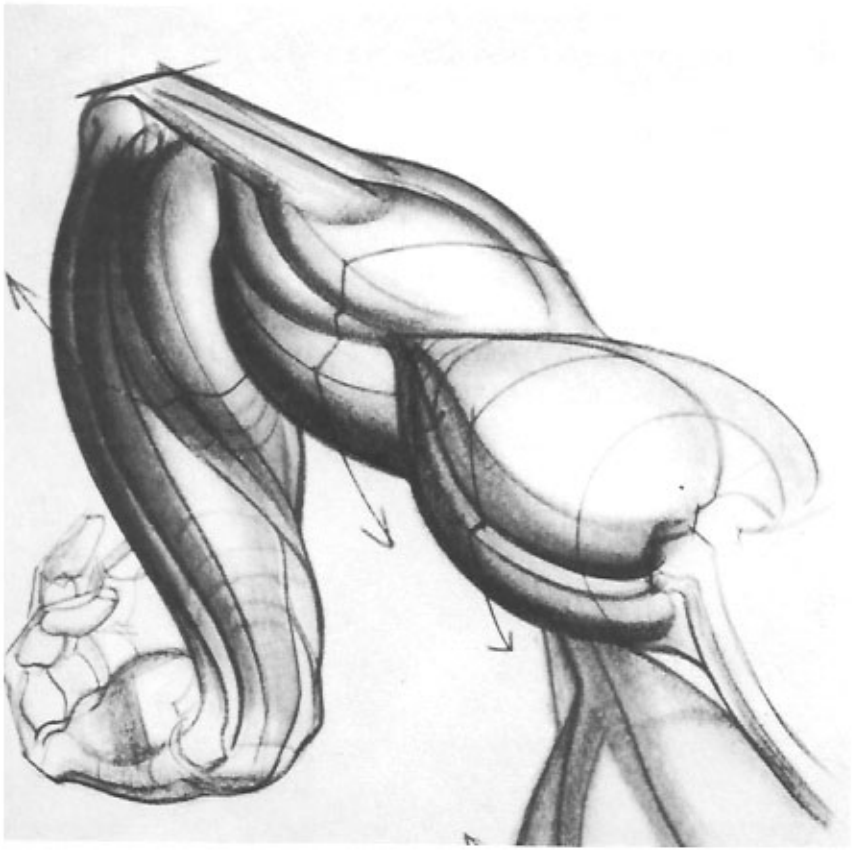
3. MEASUREMENTS. The upper arm, starting at the shoulder girdle, drops to a line drawn across the torso from the umbilicus through the mid-position of the externus oblique. Thus, the bend of the elbow lines up with the navel. From this position, the lower arm moves down to the wrist at a point in line with the great trochanter, the bony prominence high on the side of the leg. This point lies on the line drawn across the lower torso from the pubic arch front to the coccyx bone rear. We must note that the deltoid muscle is fully a head-length deep on the side of the arm, and this position lies across the line of the base of the pectorals on the chest, front, and across the base of the shoulder blades, rear. The biceps muscle in the front upper arm is one head in length from pectoral to forearm. The entire length of arm may be said to be two and three-quarter heads long, from shoulder height to wrist. With the hand added, the arm is three and a half heads long.



4. THE ELBOW. The elbow presents a large triangulated protruding surface at the back joint of the arm. The backward projection, olecranon, the elbow protrusion of the ulna, is a broad, hooked form which acts as a locking device in straightening the arm. It narrows to a thin wedge. On either side of this prominence, the upper arm bone, humerus, opens a fossa to receive it. The humerus base has two large side projections both of which are visible from the rear The inner is larger and more dominant. The elbow area thus formed, with its side points wide and hook thrust back, appears visually like an inverted pyramid support. The head of the radius, seen on the side upper forearm, is hardly visible under the arched mound of the brachioradialis muscle.







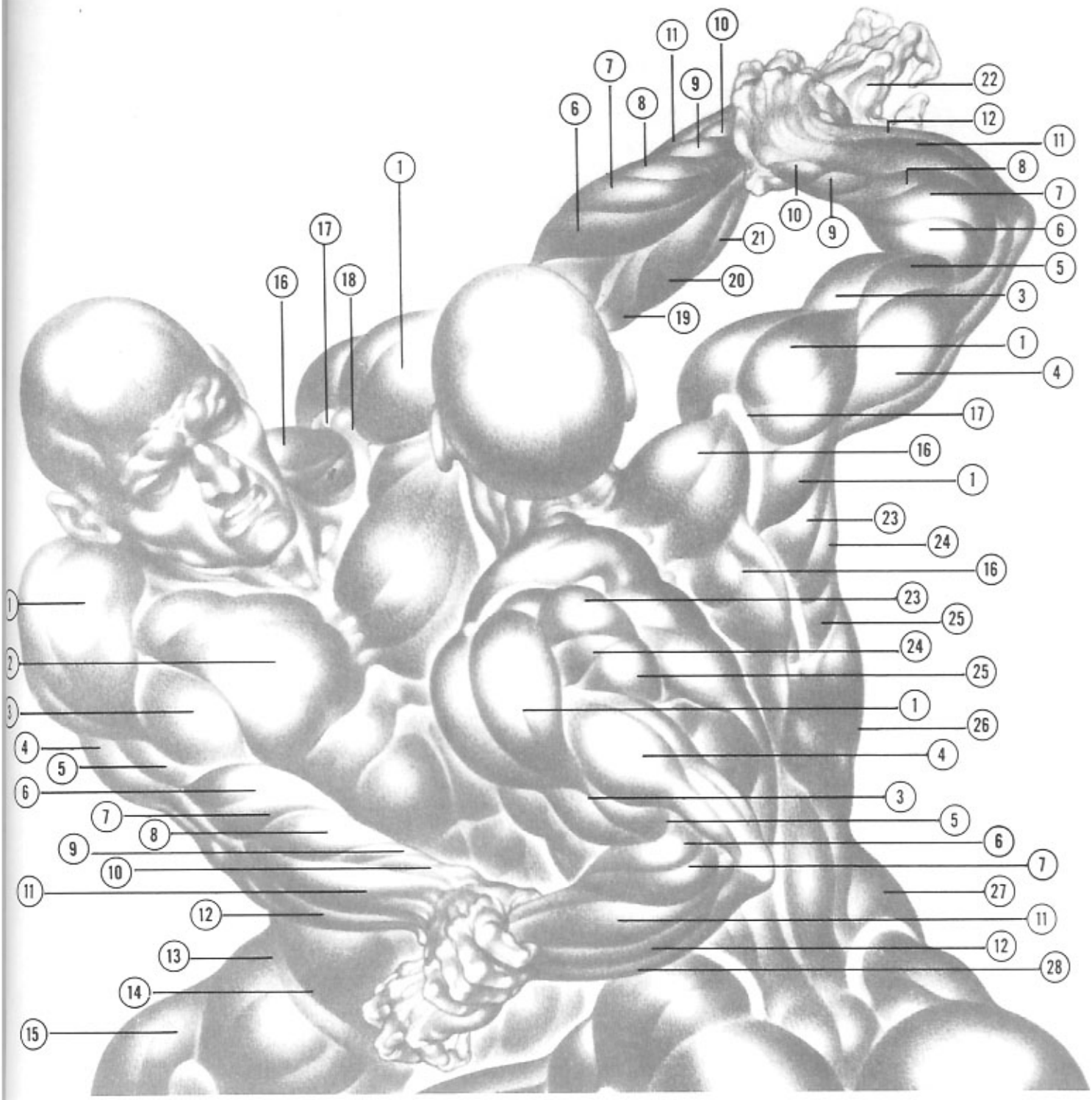
1. DELTOID
2. PECTORALIS MAJOR
3. BICEPS
4. TRICEPS
5. BRACHIALIS
6. BRACHIORADIALIS
7. EXTENSOR CARPI RADIALIS LONGUS
8. EXTENSOR CARPI RADIALIS BREVIS
9. ABDUCTOR POLLICIS LONGUS
10. EXTENSOR POLLICIS BREVIS
11. EXTENSOR DIGITORUM
12. EXTENSOR CARPI ULNARIS
13. GLUTEUS MEDIUS
14. ILIAC CREST
15. GLUTEUS MAXIMUS
16. TRAPEZIUS
17. ACROMION
18. CLAVICLE
19. PRONATOR TERES
20. FLEXOR CARPI RADIALIS
21. PALMARIS LONGUS
22. INTEROSSEUS
23. INFRASPINATUS
24. TERES MINOR
25. TERES MAJOR
26. LATISSIMUS DORSI
27. EXTERNUS OBLIQUE
28. FLEXOR CARPI ULNARIS

5. POINTS TO REMEMBER IN DRAWING. The flat part of the wrist is locked to the flat part of the palm. It *never* changes. Thus, as the arm turns, the palm turns.

The turn of the palm on the forearm can complete a full half circle, or a 180-degree arc of movement from supination to pronation.

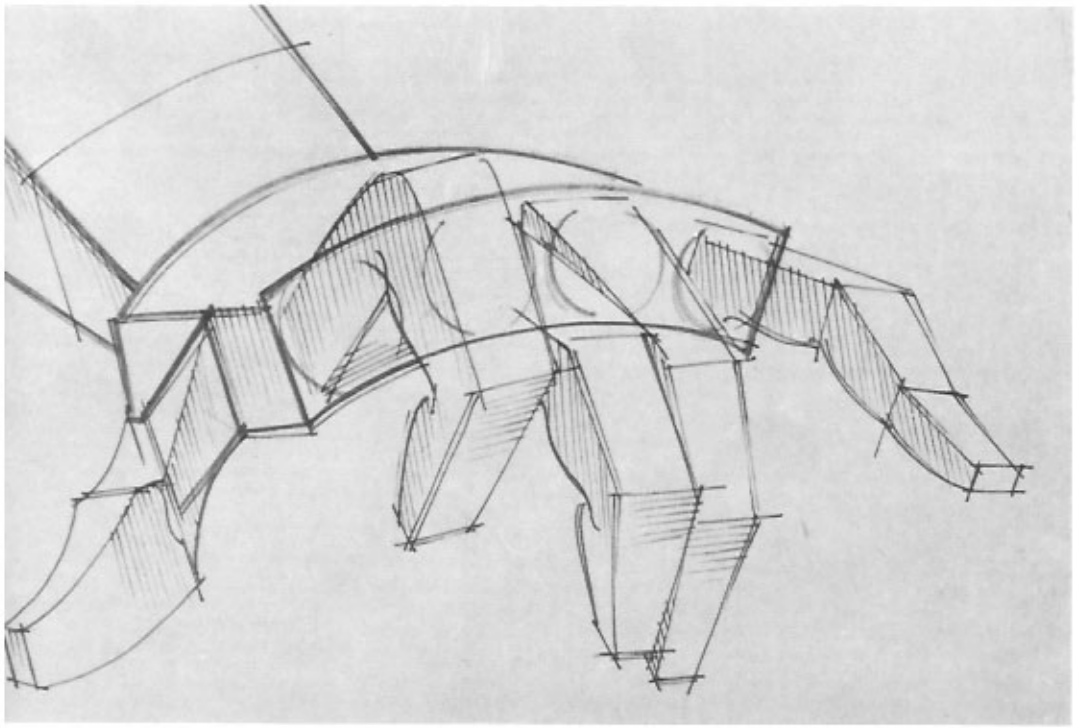
The flexor muscle mass on the under forearm is separated from the upper extensor mass by the line of the ulna, the bony edge running from the elbow to the outside head of the wrist.

The arms have tremendous freedom of movement. To understand their capacity for activity, the arms must be understood to attach to the body not at the shoulders, but into the pit of the neck. The clavicles, therefore, are really additional extensions to the arm lengths; thus, the complex of bone lengths produces a mechanism with an unusual ability for movement.

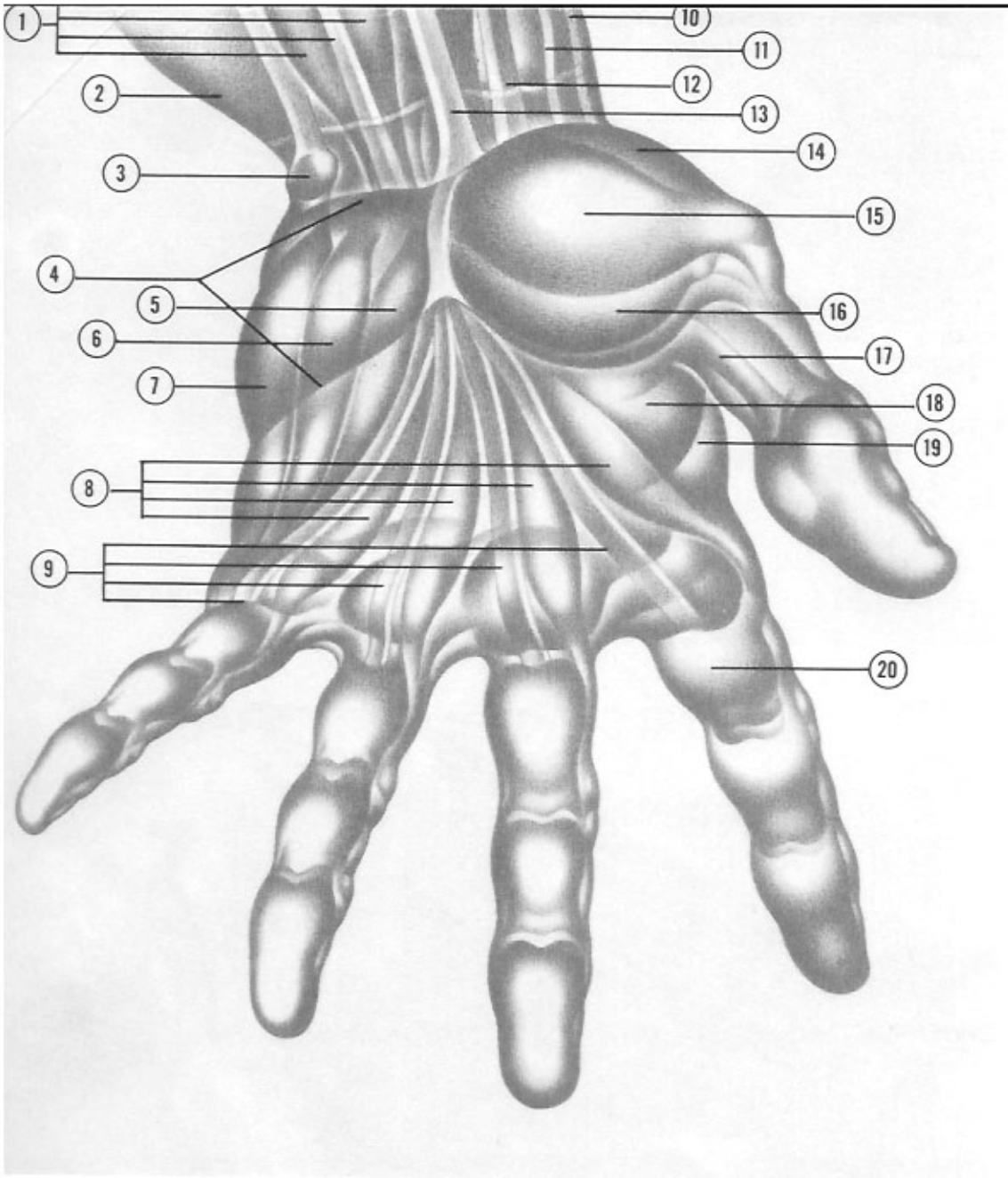

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THE HAND

1. THE MASSES OF THE HAND. The palm of the hand is a flat, square-shaped wedge of form, somewhat thicker and wider at the wrist, and slightly narrower and thinner at the fingers. The palmar side has three mounded masses: the thenar group or ball of the thumb; the hypothenar prominence above the little finger; and the lumbrical pads across the base of the palm. A deep triangulated hollow lies in the center of the palm. The interosseus muscles are below, but they present little surface appearance. The dorsal or back view of the palm presents a hard, bony surface, dominated by the series of tendons moving down from wrist to fingers across the projecting ramp of knuckles.

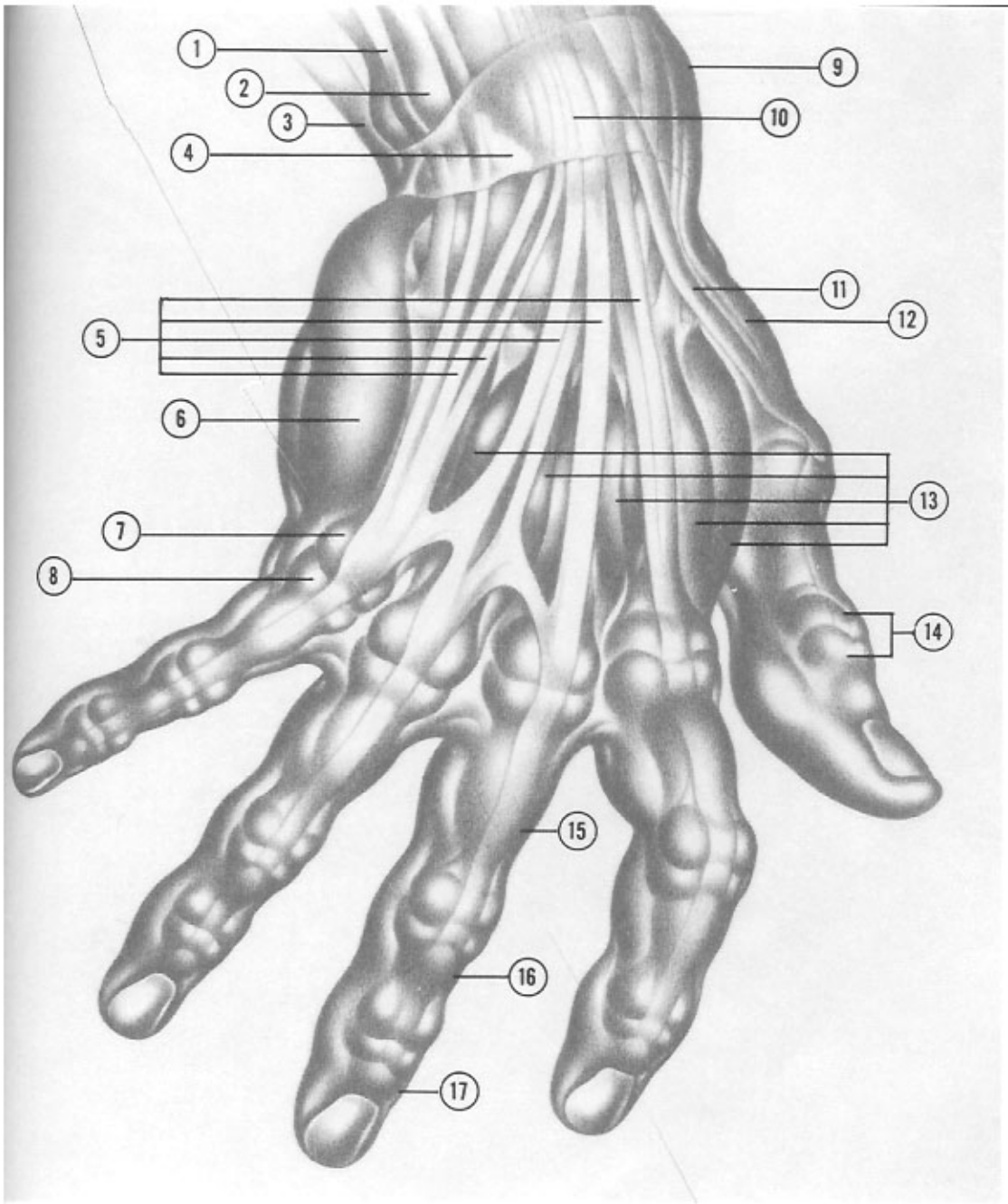






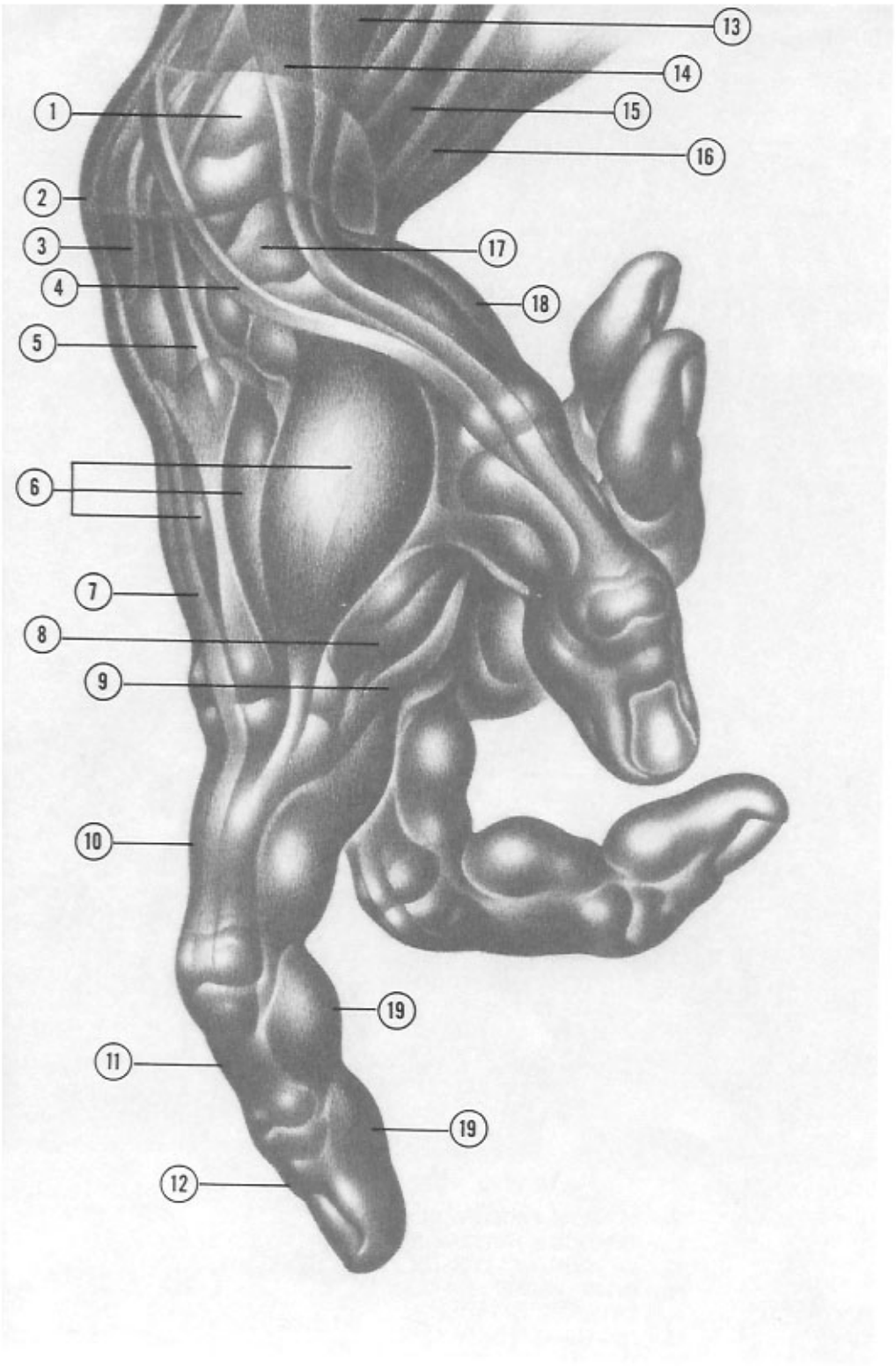
1. FLEXOR DIGITORUM SUBLIMIS
2. FLEXOR CARPI ULNARIS
3. PISIFORM BONE
4. PALMARIS BREVIS
5. OPPONENS DIGITI QUINTI
6. FLEXOR DIGITI QUINTI BREVIS
7. ABDUCTOR DIGITI QUINTI
8. LUMBRICALS
9. TENDONS – FLEXOR DIGITORUM SUBLIMIS
10. EXTENSOR POLLICIS BREVIS
11. ABDUCTOR POLLICIS LONGUS
12. FLEXOR CARPI RADIALIS
13. PALMARIS LONGUS
14. OPPONENS POLLICIS
15. ABDUCTOR POLLICIS BREVIS
16. FLEXOR POLLICIS BREVIS
17. TENDON – FLEXOR POLLICIS LONGUS
18. ADDUCTOR POLLICIS
19. INTEROSSEUS
20. FINGER PAD

Two muscle forms are visible on the back palm: the rather large interosseus muscle, between thumb and forefinger, and the abductor minimi muscle on the outer edge of the palm above the little finger.



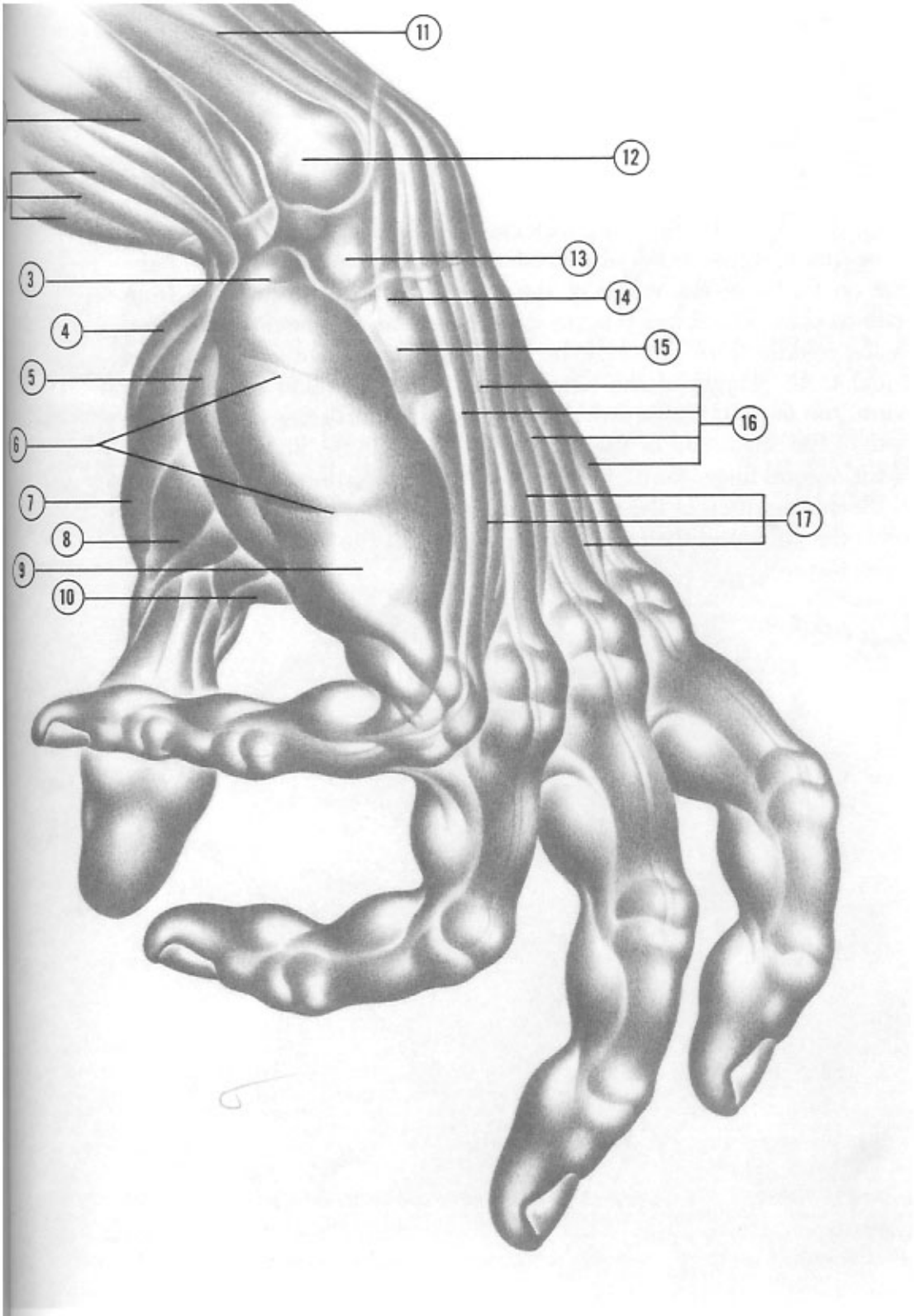
1. TENDON – EXTENSOR CARPI ULNARIS
2. ULNA BONE
3. FLEXOR CARPI ULNARIS
4. ANNULAR LIGAMENT
5. TENDONS – EXTENSOR DIGITORUM
6. ABDUCTOR DIGITI QUINTI
7. HEAD – FIFTH METACARPAL
8. BASE – FIFTH PROXIMAL PHALANX
9. STYLOID PROCESS – RADIUS BONE
10. LUNATE PROMINENCE
11. TENDON – EXTENSOR POLLICIS LONGUS
12. TENDON – EXTENSOR POLLICIS BREVIS
13. INTEROSSEUS MUSCLES
14. KNUCKLE CAPSULE
15. PROXIMAL PHALANX (I)
16. MEDIAN PHALANX (II)
17. TERMINAL PHALANX (III)

The fingers show no muscular masses; their undersurfaces are soft and padded for gripping and clenching, while their top surfaces are quite skeletal, revealing marked protrusions of the knuckle capsules.



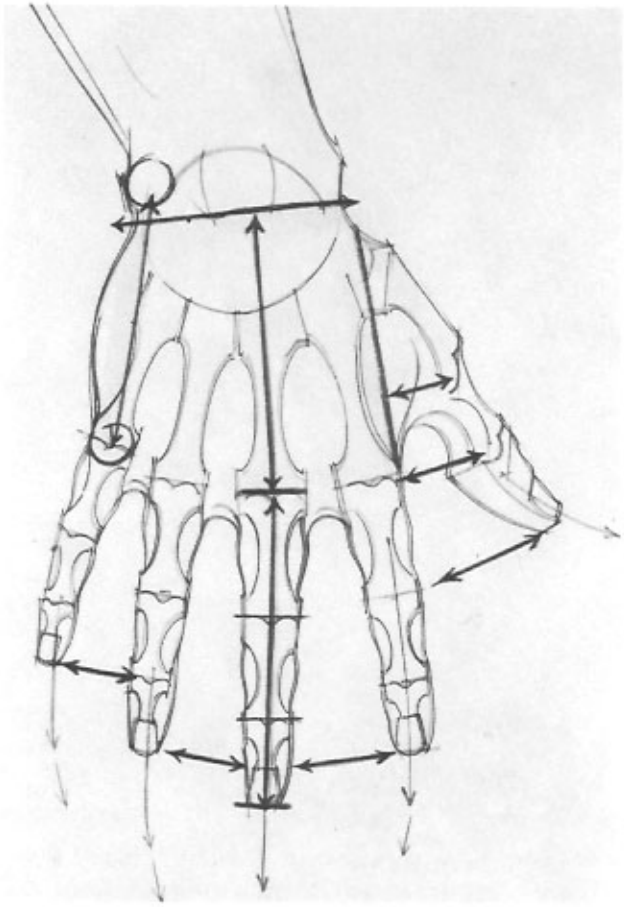
1. ANNULAR LIGAMENT
2. LUNATE PROMINENCE
3. TENDON – EXTENSOR CARPI RADIALIS BREVIS
4. TENDON – EXTENSOR POLLICIS LONGUS
5. TENDON – EXTENSOR CARPI RADIALIS LONGUS
6. INTEROSSEUS MUSCLES
7. TENDON – EXTENSOR DIGITORUM
8. ADDUCTOR POLLICIS
9. LUMBRICAL
10. PROXIMAL PHALANX (I)
11. MEDIAN PHALANX (II)
12. TERMINAL PHALANX (III)
13. ABDUCTOR POLLICIS LONGUS
14. EXTENSOR POLLICIS BREVIS
15. FLEXOR CARPI RADIALIS
16. PALMARIS LONGUS
17. TRAPEZIUM CARPAL BONE
18. OPPONENS POLLICIS
19. FINGER PADS

The wrist bones on the back surface of the palm show a major mound when the palm is flexed, the lunate or semilunar carpal bone, lying between the acclusion of the radius and ulna at the wrist. Over this mound, the ramp of extensor tendons descends to the fingers.



1. FLEXOR CARPI ULNARIS
2. FLEXOR DIGITORUM SUBLIMIS
3. PISIFORM BONE
4. OPPONENS POLLICIS
5. FLEXOR DIGITI QUINTI BREVIS
6. PALMARIS BREVIS
7. ABDUCTOR POLLICIS BREVIS
8. FLEXOR POLLICIS BREVIS
9. ABDUCTOR DIGITI QUINTI
10. ADDUCTOR POLLICIS
11. EXTENSOR CARPI ULNARIS
12. ULNAR HEAD
13. TRIQUETRUM CARPAL BONE
14. TENDON – EXTENSOR CARPI ULNARIS
15. HAMATE CARPAL BONE
16. TENDONS – EXTENSOR DIGITORUM
17. INTEROSSEUS MUSCLES

2. MEASUREMENTS. The length of the hand measures three-quarters the length of a head, or the distance from chin to hairline on the face; the width of the hand measures the distance from nose to chin. The finger lengths derive their measurements according to the middle third finger of the hand. It is the longest finger and is equal to the length of the palm. Thus, using the middle finger as a norm, the lengths of the index finger and the fourth finger end at the base of the finger nail of the middle finger, while the little finger ends at the second finger joint of the fourth finger. The thumb wedge starts in the mid-position of the palm. The first joint lines up with the knuckles of the palm and then ends at the position of the first knuckle of the index finger.



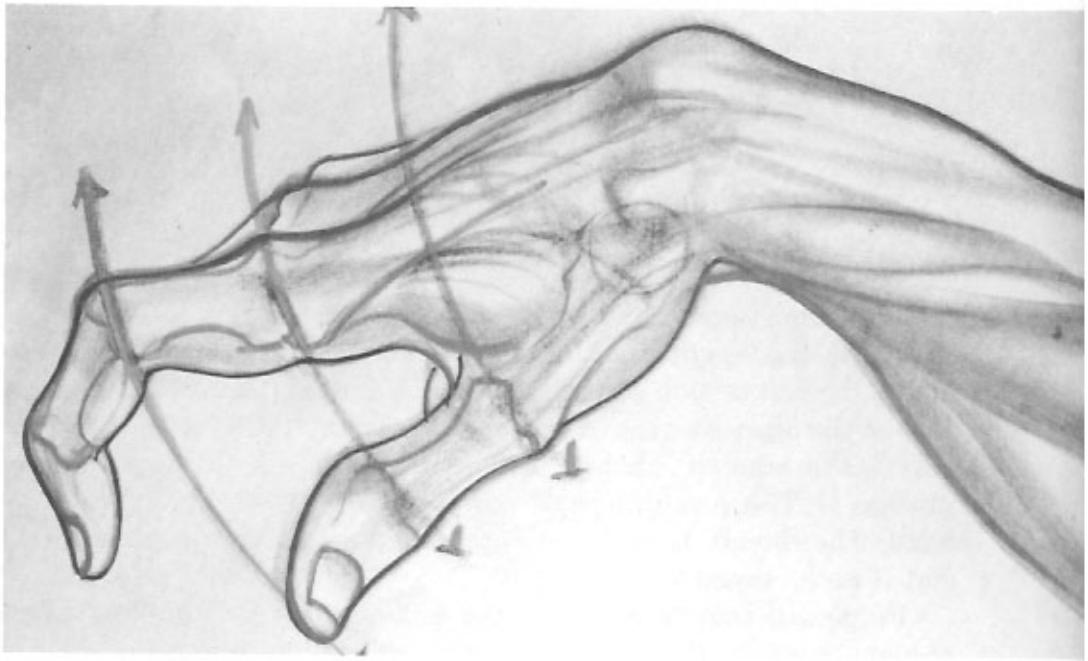


Each finger section, with the exception of the thumb, divides at two-thirds the length of a *preceding* section. For instance, in the index finger, the first section phalanx I is a third longer than middle phalanx II — or the other way round — phalanx II is two-thirds as long as phalanx I; the smallest, phalanx III, is, therefore, two-thirds as long as phalanx II. This measuring system applies to all the four fingers of the hand. The thumb, however, is simpler: its two sections, phalanges I and II are of equal lengths.

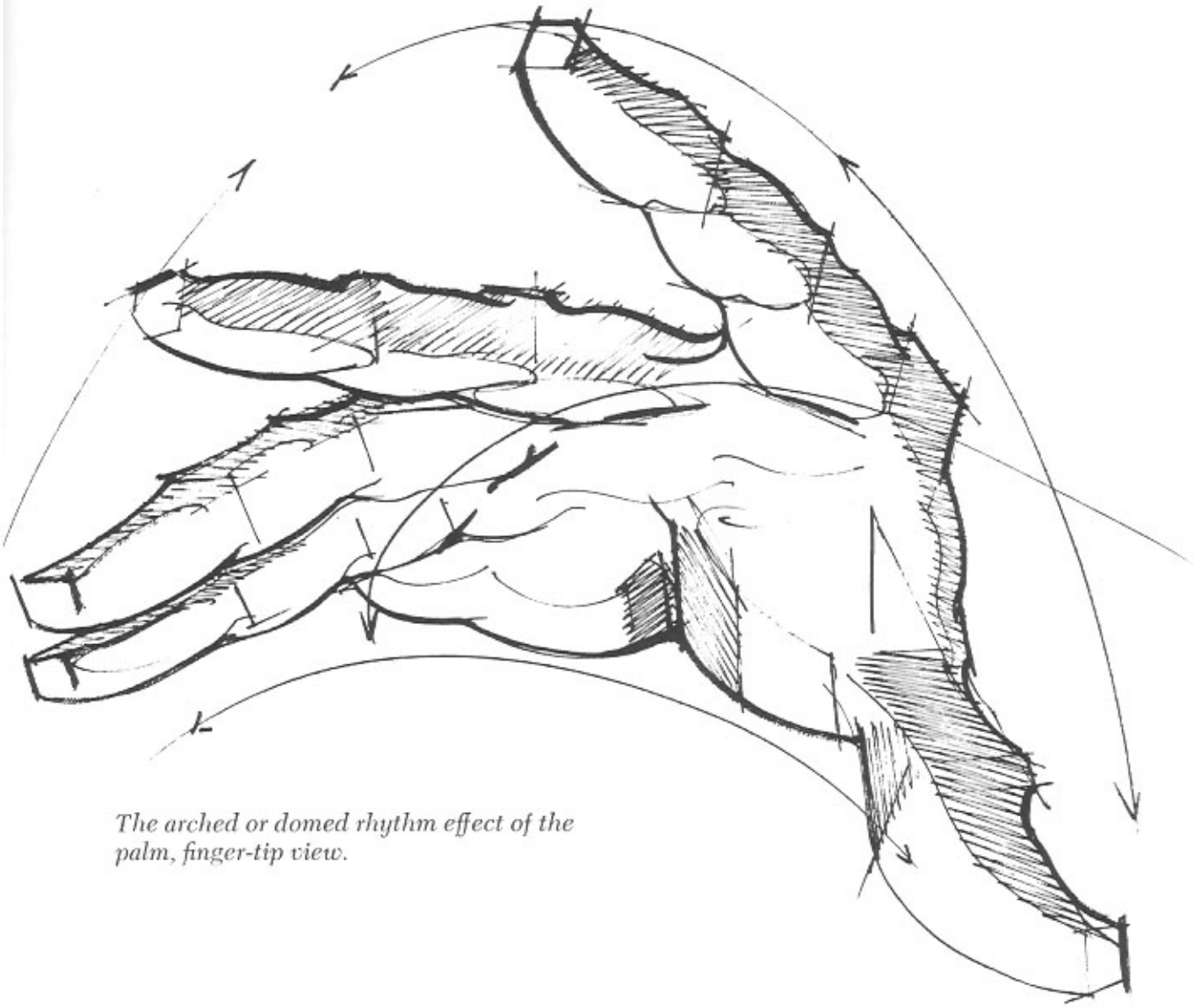
Fingernail lengths lie across the mid-point of the terminal finger sections, phalanx III of each finger, including the thumb.

3. ACTIVITY OF THE HAND. The hand may be said to have three kinds of activity: *rhythm*, developed from a relationship of the parts in structure and form; *action*, developed from the capability of the hand to operate in a specific manner; *movement*, developed from the *visual* pattern of behavior in the action of the hand.

Rhythm: (1) From a side position looking across the top of the hand, the palm and fingers have a *wavelike* rhythm. The wave rhythm can be observed on the entire length of the forearm, rising over the wrist, dropping down the palm, rising over the finger, down again, and up the lift of the fingertip. The undersurface of arm and hand follows this wave motion exactly. Frequently, the difficulty in drawing the hand lies in the rigidity of fingers and palm. When the hand appears mechanical and lifeless, the wave rhythm will restore the living quality of the hand in drawing. (2) A second rhythm effect of the hand is the arched or *domed rhythm* of the palm of the hand. The palm is never flat. Thus, the fingers lie across the curved dome of the palm; the high point is equal to the middle finger and curves away on both sides to the thumb and little finger. This arch can be observed easily from a fingertip view into the palm. Note how low the thumb

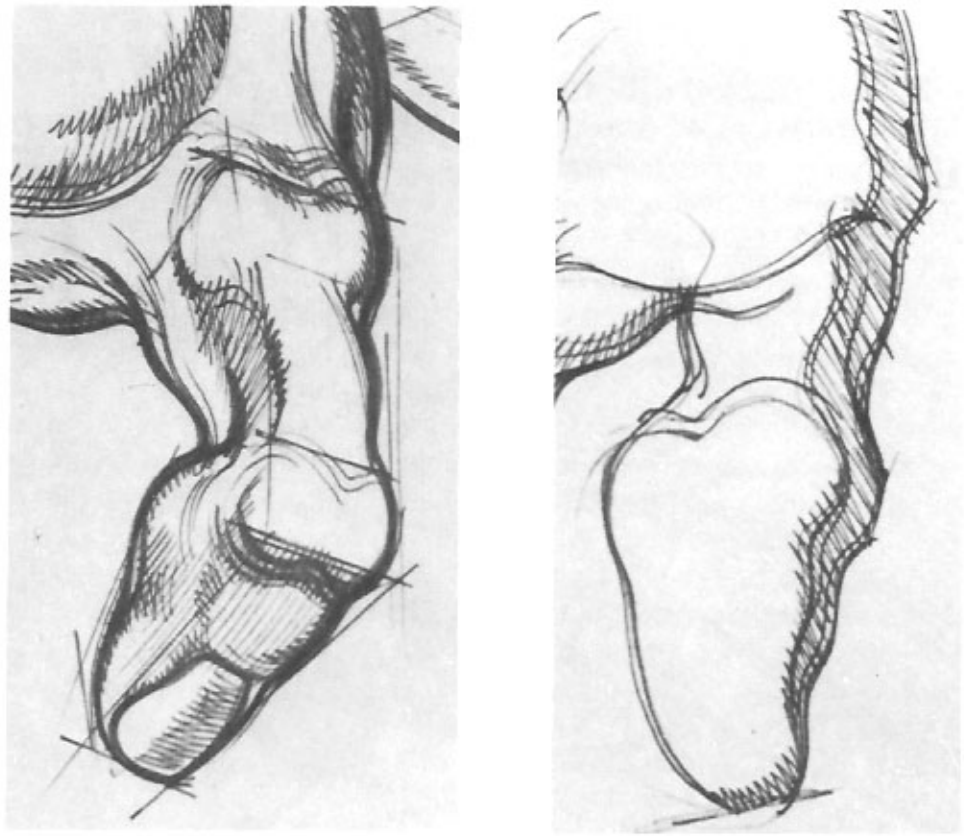


The wave rhythm of fingers, side view.

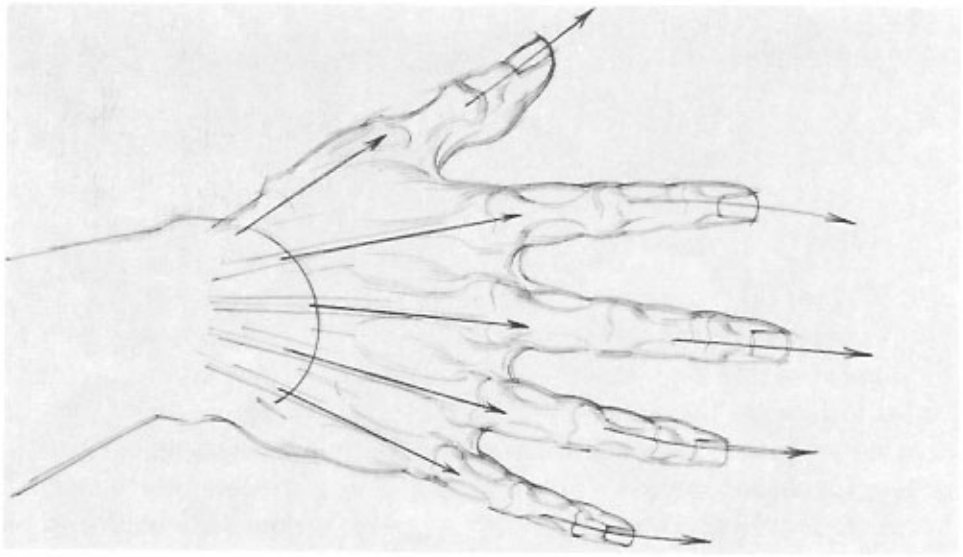


The arched or domed rhythm effect of the palm, finger-tip view.

appears from this view. (3) Looking down on the top, or dorsal view, of the hand, the fingers look like spokes of a wheel radiating from the hub in the top of the wrist. Seen this way, the longest middle finger is quite straight. The other fingers, no matter how spread, tend to curve in toward the center middle finger. Only the thumb seems to arch away from the center finger. (4) Study a section of a finger, a phalanx from a top view. The knuckle joints widen, while the shank between narrows. Thus, from this view, a symmetrical rhythm of widening and narrowing on all fingers can be observed. The thumb shows the effect most clearly.



The symmetrical rhythm: widening and narrowing of bone forms.



Fingers tend to curve in to the long middle finger.

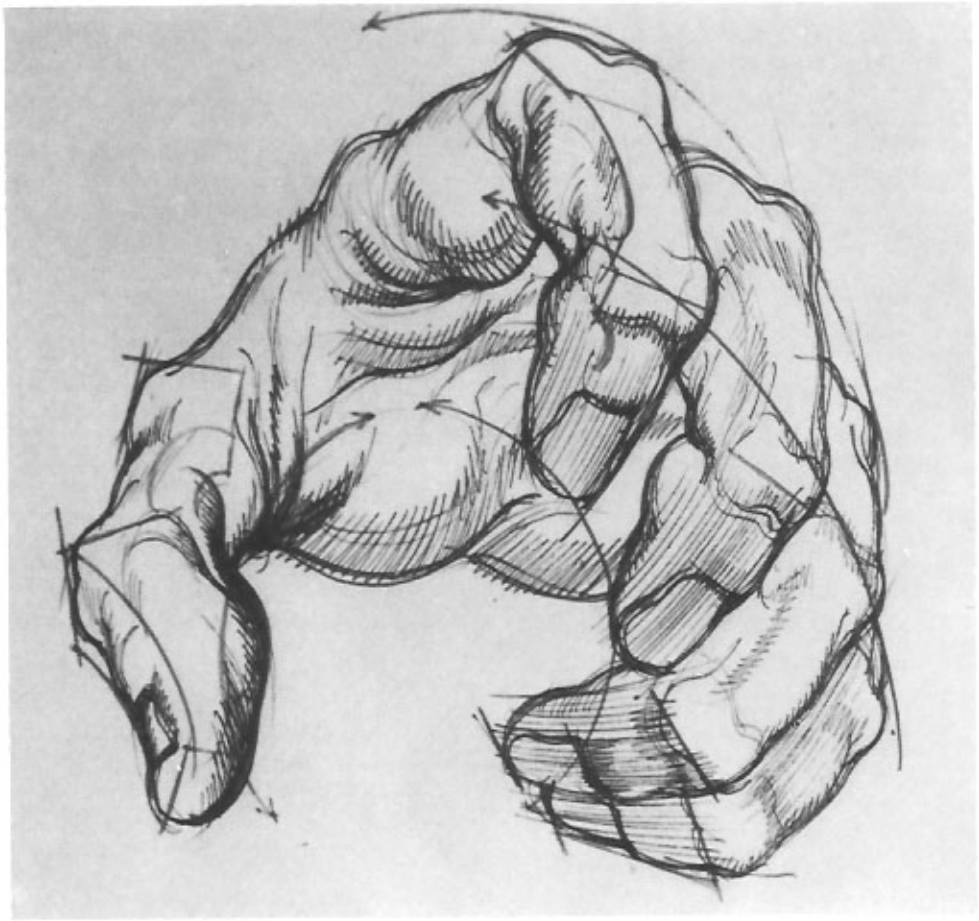


Action: (1) In the *flexing action* of the fingers, *all fingers* close to an angle of 90 degrees, or a right angle bend at the knuckles. In closing a fist, each finger closes the joints to the 90-degree square corner position. (2) The wrist in flexion can be bent to a 90-degree angle. This is not quite true, however, if the fist is closed. (3) In



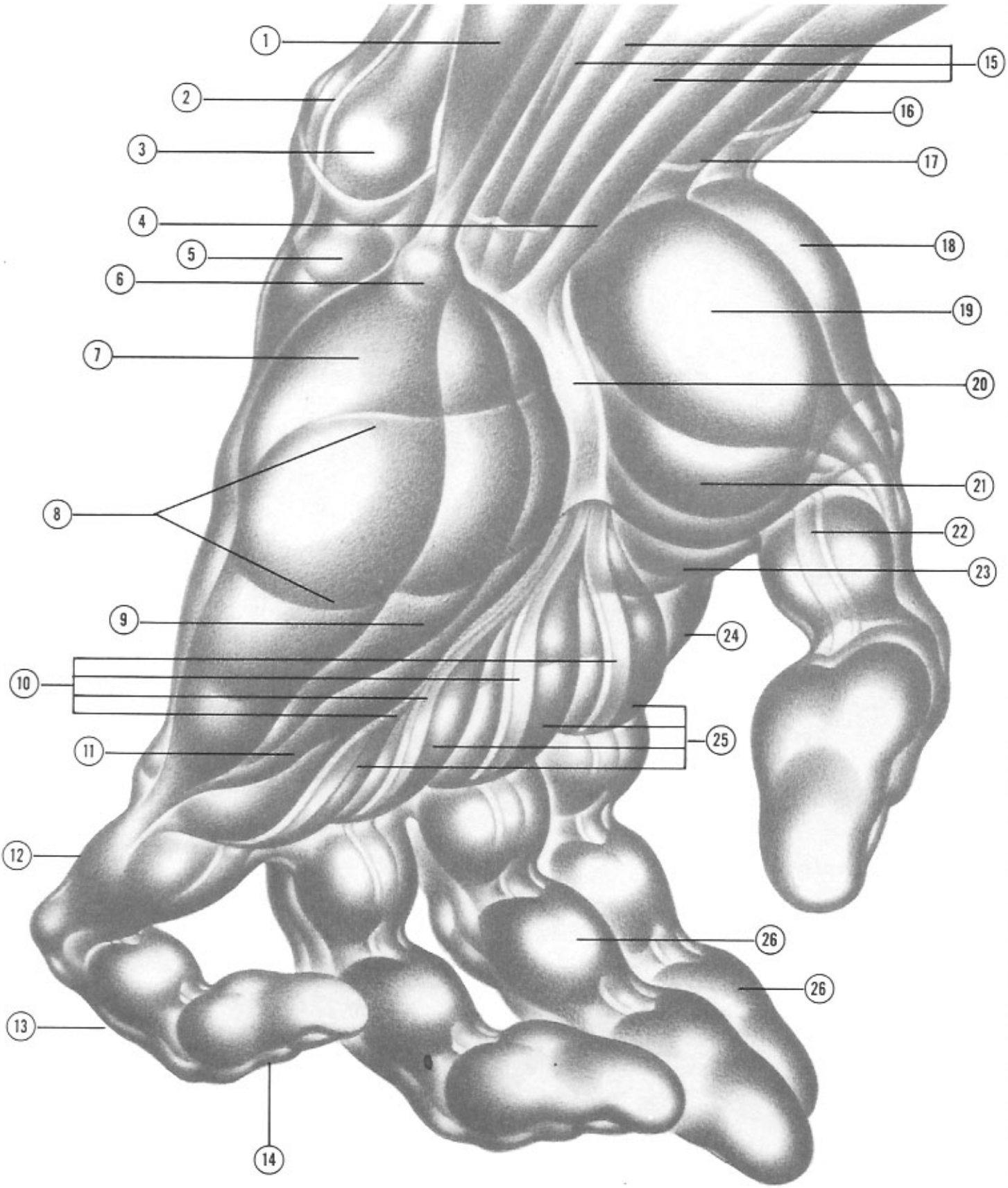


clenching the fist, the last three fingers of the hand close into the hollow triangle of the palm. The index finger closes into the thumb. Thus, the index finger in a fist is always more forward than the closure of the other three fingers. (4) In closing and unclosing the hand, the little finger *folds first*. The others follow in order, to the thumb, which is the last to close. In unclosing, the order is reversed; the thumb unfolds first, the little finger last. (5) The thumb, from a closed position against the forefinger, swings outward to a 90-degree angle with the palm. An extension of the angle in drawing may appear quite abnormal. (6) The thumb, in opposition to the palm, crosses in its extreme position to the little finger. Beyond this line it cannot go.



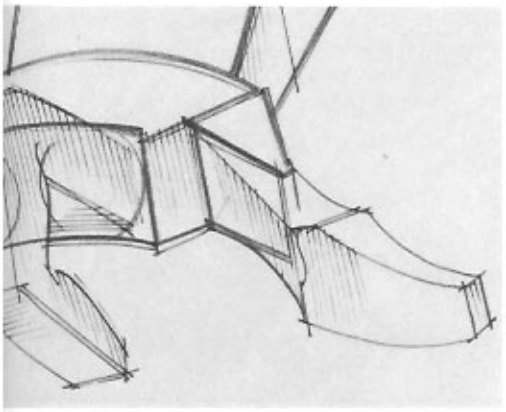
The order of closing the fingers.



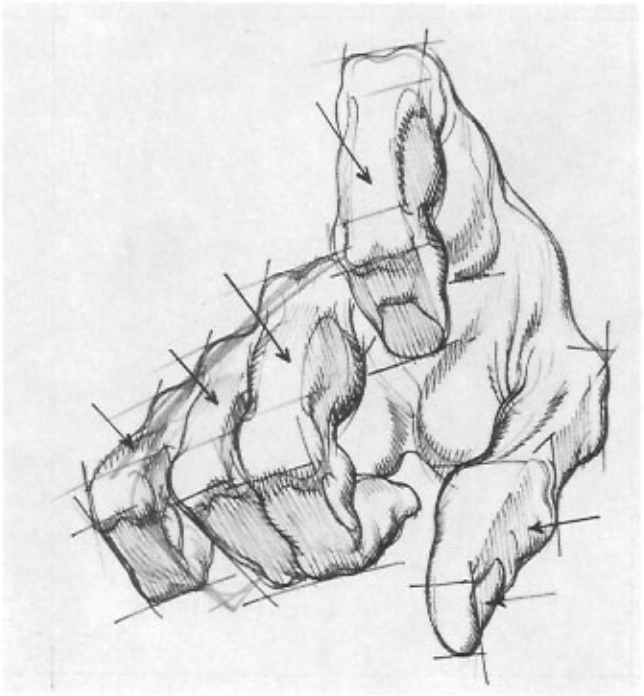

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Movement: (1) When the hand closes, the visual pattern in folding and unfolding the fingers is a spiraling movement. The observation of this movement, as well as the order of closing and opening, will enable the artist to invent positions of the hand which are natural and acceptable. Finger positions and lengths of phalanges may be easily related in drawings requiring deep foreshortening of finger forms. (2) The position of the thumb, with respect to the other fingers, lies in a tipped-over relationship to the horizontal direction of the others. Thus, if the four fingers were piano keys on a keyboard, the thumb would appear to have slipped off and lie angled on its side.

1. FLEXOR CARPI ULNARIS
2. TENDON – EXTENSOR CARPI ULNARIS
3. ULNAR HEAD
4. TENDON – PALMARIS LONGUS
5. TRIQUETRUM BONE
6. PISIFORM BONE
7. ABDUCTOR DIGITI QUINTI
8. PALMARIS BREVIS
9. FLEXOR DIGITI QUINTI BREVIS
10. TENDONS – FLEXOR DIGITORUM SUBLIMIS
11. OPPONENS DIGITI QUINTI
12. PROXIMAL PHALANX (I)
13. MEDIAN PHALANX (II)
14. TERMINAL PHALANX (III)
15. TENDONS – FLEXOR DIGITORUM SUBLIMIS
16. TENDON – ABDUCTOR POLLICIS LONGUS
17. FLEXOR CARPI RADIALIS
18. OPPONENS POLLICIS
19. ABDUCTOR POLLICIS BREVIS
20. PALMAR APONEUROSIS
21. FLEXOR POLLICIS BREVIS
22. TENDON – FLEXOR POLLICIS LONGUS
23. ADDUCTOR POLLICIS
24. INTEROSSEUS
25. LUMBRICALS
26. FINGER PADS



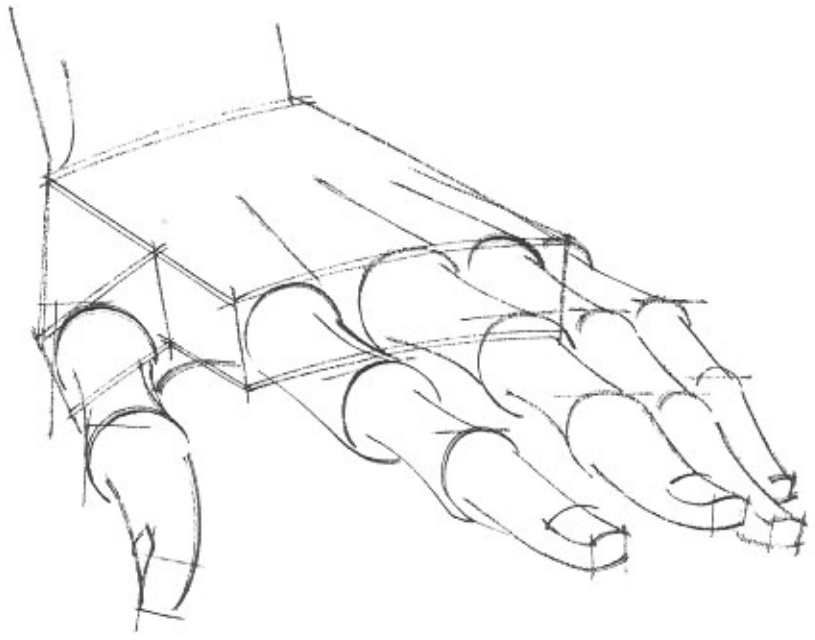
The tipped position of the thumb.

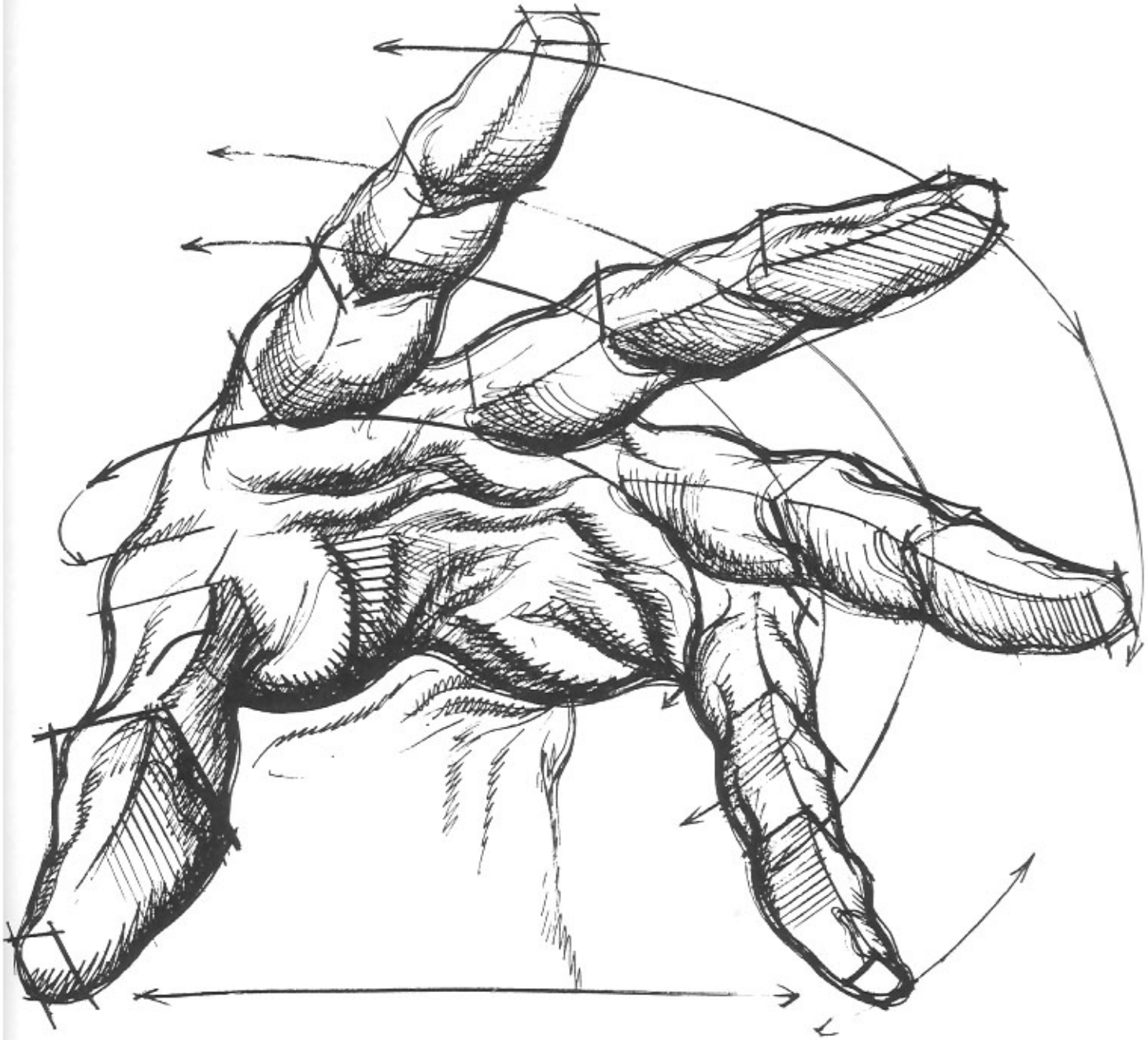


The tipped line of the thumb is generally at a 45-degree angle. In a drawing problem, the palm line should be established first. The thumb may then be added in its angle relationship to the palm. The fingers which follow will present no difficulty. (3) The pattern of knuckles from a top view of the hand shows a curvilinear movement: a series of elliptical curves moving across palm knuckles and finger knuckles, to a very tight ellipse curve on the fingertips. Notice how the spread of fingers opens the ellipse pattern to a flatter parabolic arc.

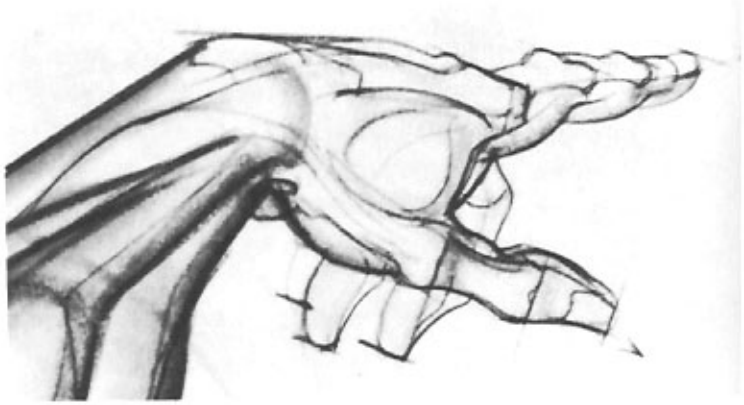
4. POINTS TO REMEMBER IN DRAWING: (a) To orient the eye in drawing the foreshortened hand, the palm may be seen as a thick, arched wedge of coconut, with the fingers pushed into the thick end like rods. Looking into one of the finger rods, the knuckles seen on end will give the appearance of a chain of beads, one overlapping the other.

(b) Place your hand before you on a table, with the fingers slightly spread, touching the surface. Viewing from the back of the hand, observe how the thumb lies across the same position in depth with the little finger. Without moving the parts, lift the hand and look under. The middle fingers angle down away from the eye. The thumb and little finger are now virtually *erect*, and of *equal length*. Turn the hand and study the position, palm up. To draw a back of the hand view, with an under palm surface, the thumb and little finger must *first be related* as equal in length and position in space. The others descend from these, sloping into the depth of space.









(c) To place the hand correctly on the arm, the hand will be seen to thrust *away* from the body, while the arm moves *toward* the body. This tendency of thrust is equivalent to the stance of feet pointing away from the body line. It is similar to the position of toes in animals. This idea is especially important in deep foreshortening of the hand and arm.

(d) In relating hand and arm together, observe how the inside contour of the index finger passes through the palm to the *inside contour* of the forearm. The view looking on top of the palm is easy enough to understand. However, try looking into the hand from the fingertips. To draw this view may be troublesome. Relating hand and arm is simplified if the contour check is used.

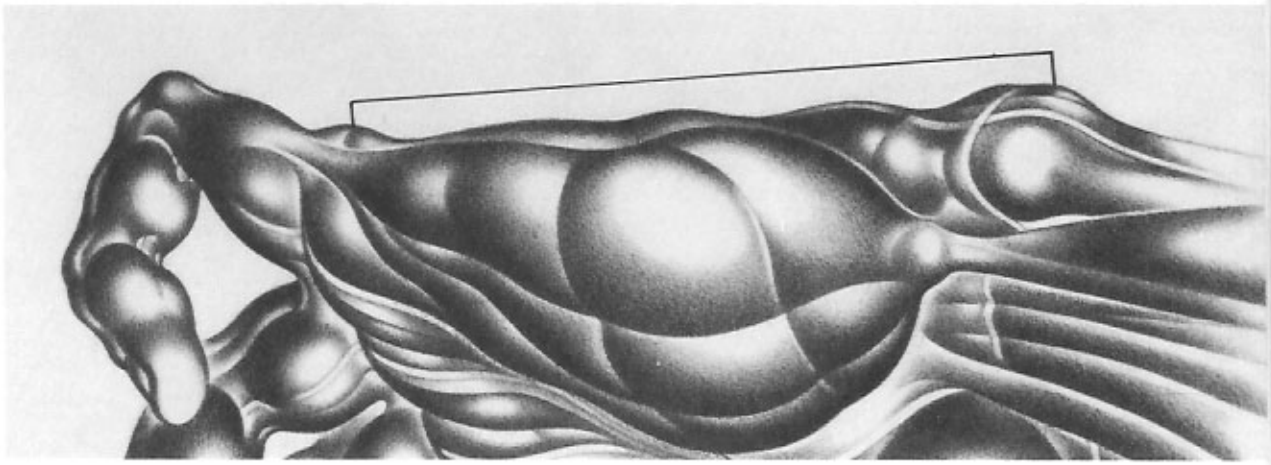
(e) Another check line is the little finger contour lining up with the outer contour of the arm. Here, the ulnar head in the wrist is directly in line with the little finger knuckle of the palm. They are equal in line and height. Thus, thickness of palm and arm and placement of the top bones are accounted for in difficult views.

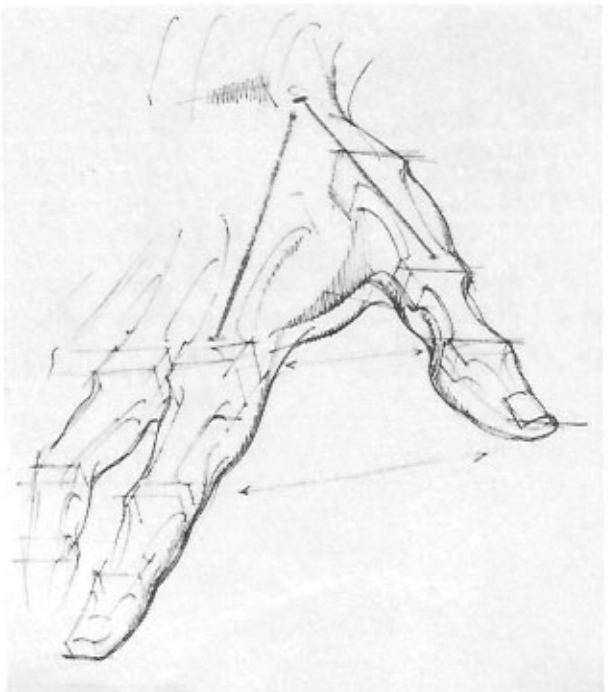
(f) To place the thumb in the palm, notice how the index finger and thumb line come together high up in the wrist, where the arm joins the palm. This angle relationship should be used whenever the thumb presents a placement problem in drawing.

(g) Fingers are webbed *below* the knuckles of the palm, on the undersurface of the hand. Top surface form will thus override the lower webbed base.



The index finger-radius line, and the little finger-ulnar line.

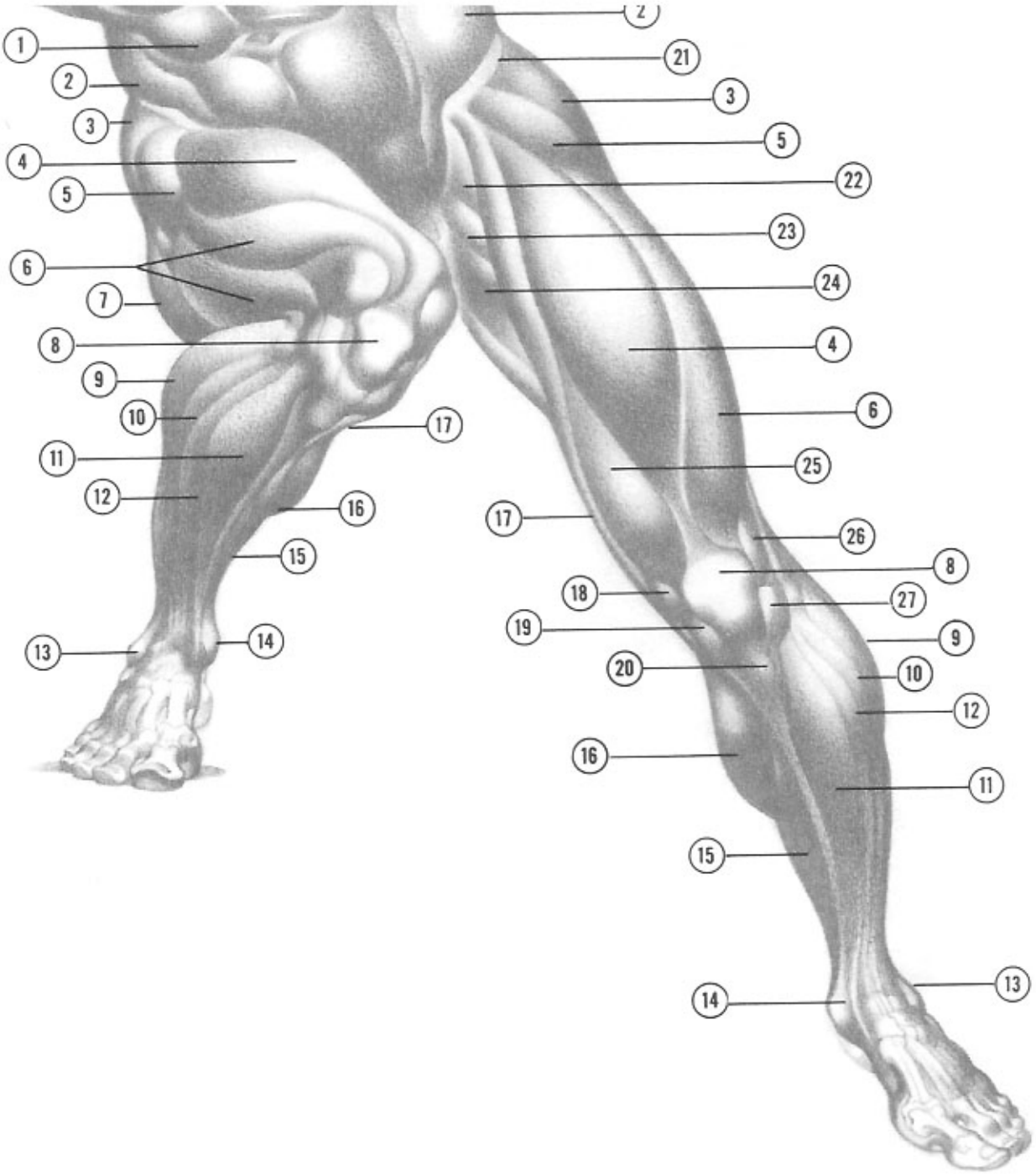




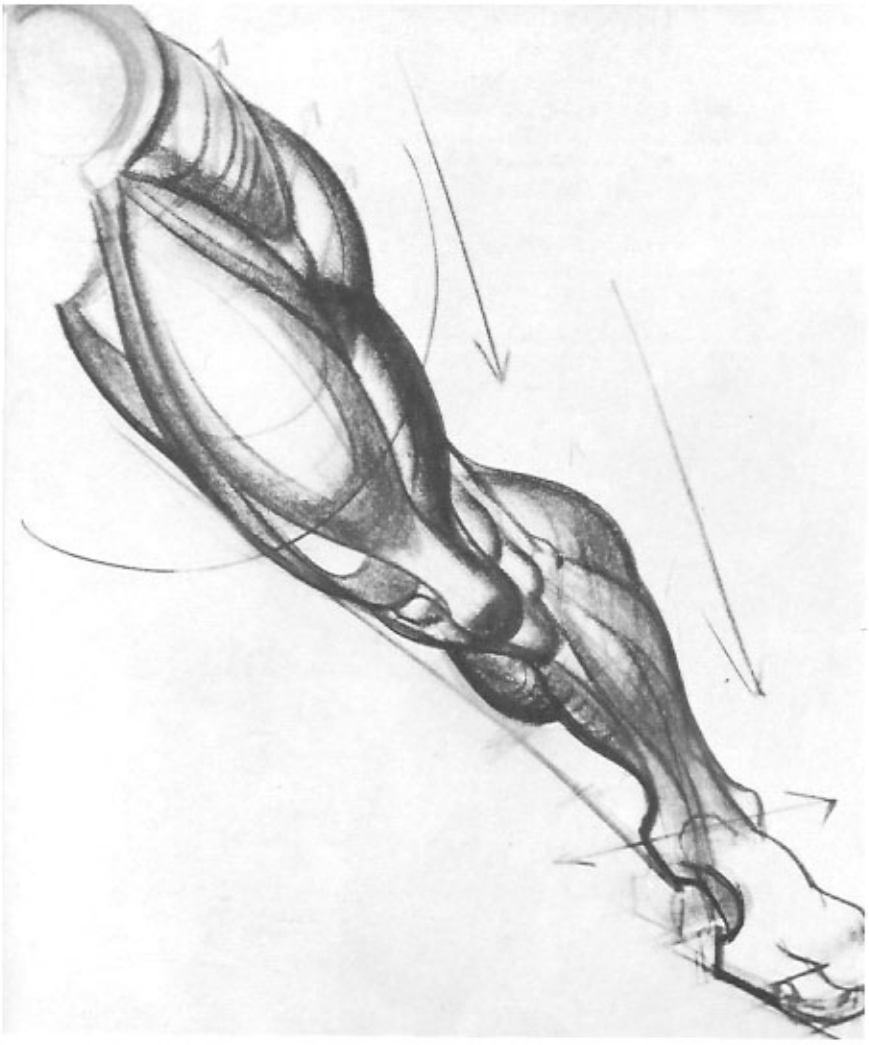


THE LEG

1. THE UPPER LEG MASSES. The upper leg presents a roundly-formed tapered cylinder, somewhat flat on the inner leg area, but markedly broad at the trochanter and compressed toward the knee.



1. RECTUS ABDOMINIS
2. EXTERNUS OBLIQUE
3. GLUTEUS MEDIUS
4. RECTUS FEMORIS
5. TENSOR FASCIAE LATAE
6. VASTUS EXTERNUS
7. GLUTEUS MAXIMUS
8. PATELLA
9. GASTROCNEMIUS
10. SOLEUS
11. TIBIALIS ANTERIOR
12. PERONEUS LONGUS
13. LATERAL MALLEOLUS
14. MEDIAL MALLEOLUS
15. SOLEUS
16. GASTROCNEMIUS
17. SARTORIUS
18. MEDIAL CONDYLE – FEMUR
19. MEDIAL CONDYLE – TIBIA
20. TIBIAL TUBEROSITY
21. ILIAC CREST
22. ILIOPSOAS
23. PECTINEUS
24. ADDUCTOR LONGUS
25. VASTUS INTERNUS
26. LATERAL CONDYLE – FEMUR
27. LATERAL CONDYLE – TIBIA

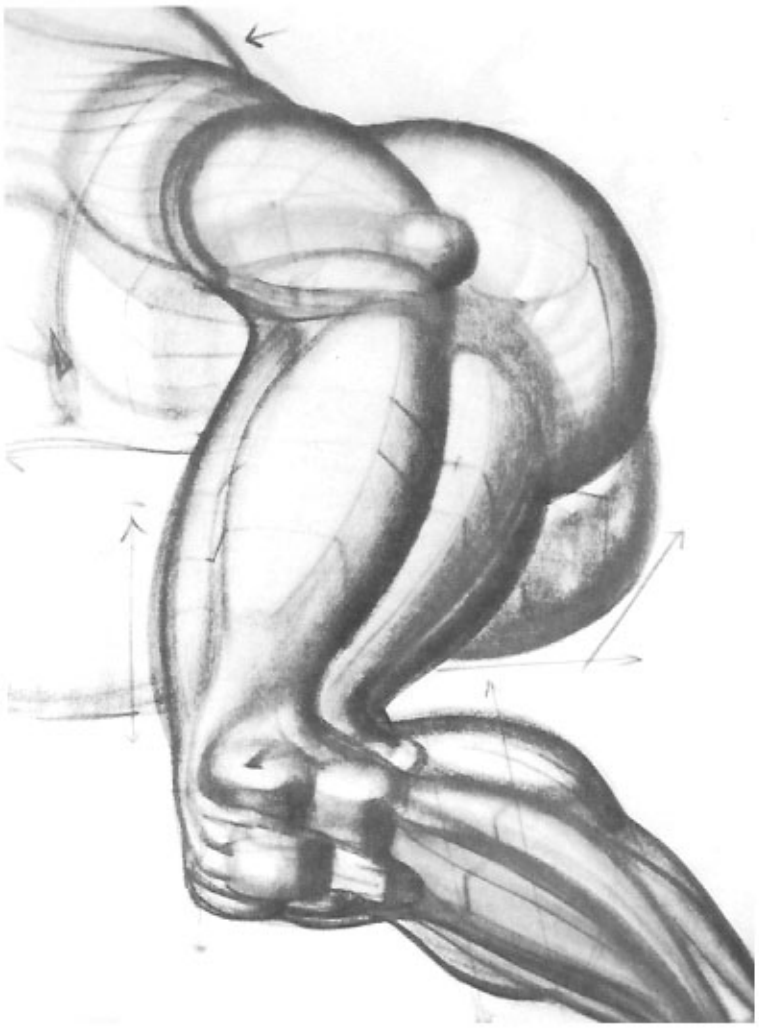


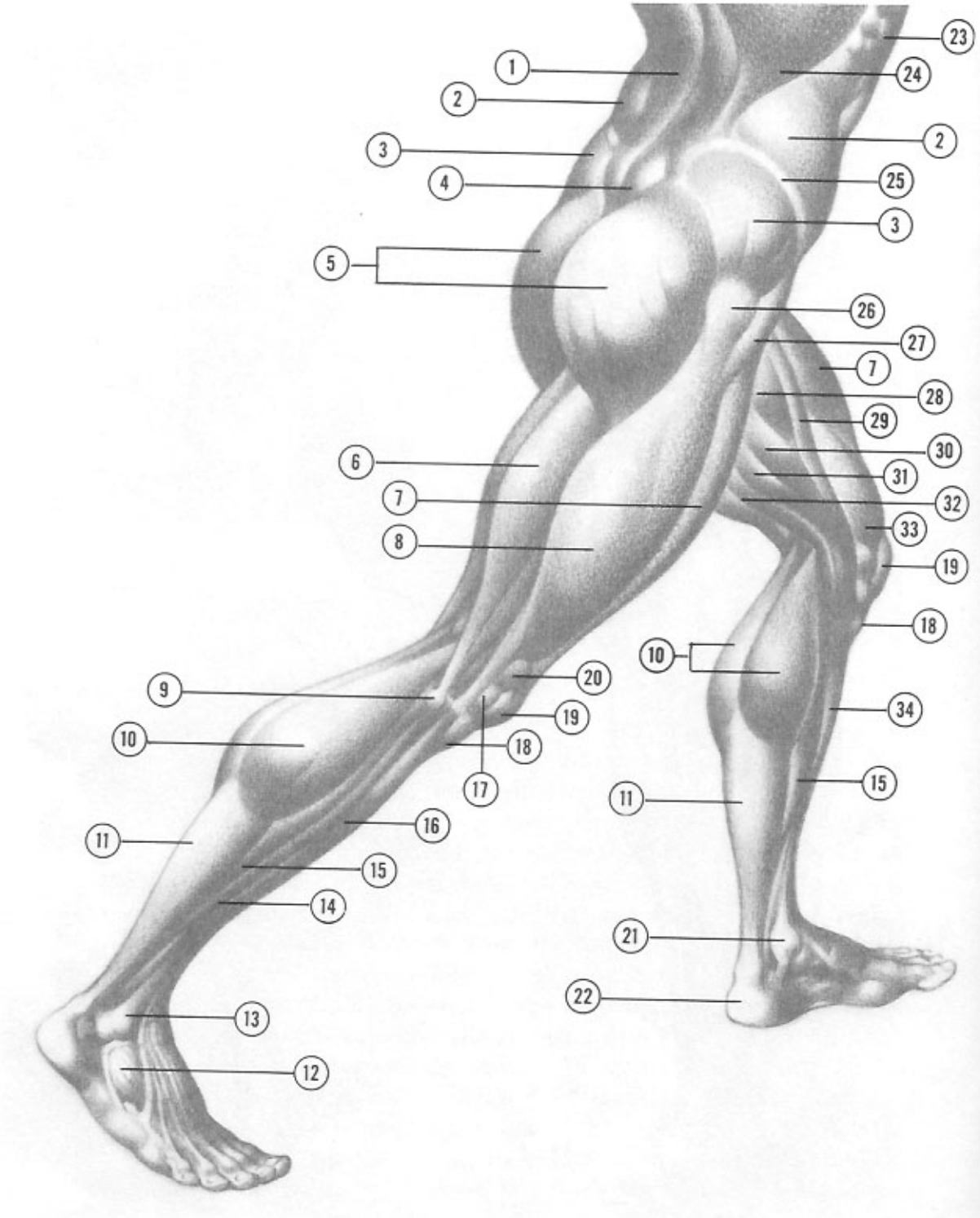
The outer leg masses present markedly compressed or tapered forms.

The upper leg, front view, consists of five major muscle masses and two minor masses. The leg, for clarification, originates high in the pelvic girdle at the iliac crest. Thus, the front upper leg masses are: gluteus medius, filling the space between the iliac crest and the trochanter; the powerful side mass below the trochanter, vastus externus, sending its tendon to the knee cap; the long middle column, rectus femoris, descending vertically from the anterior pelvis across the patella to the tibia; the vastus internus, starting on the middle inside area of the leg and turning lower, to form a common tendon with rectus femoris and vastus externus; the adductor and pectineus group, high inside the leg, moving into the pelvis at the groin line. The two smaller masses, tensor fascia and sartorius, both originating on the high anterior point of the pelvis, divide right and left. Tensor swings outside to an attachment just below the trochanter, while sartorius, the longest muscle in the body, winds down the inside leg channel beside rectus and vastus internus, around the knee to the inside upper tibia.



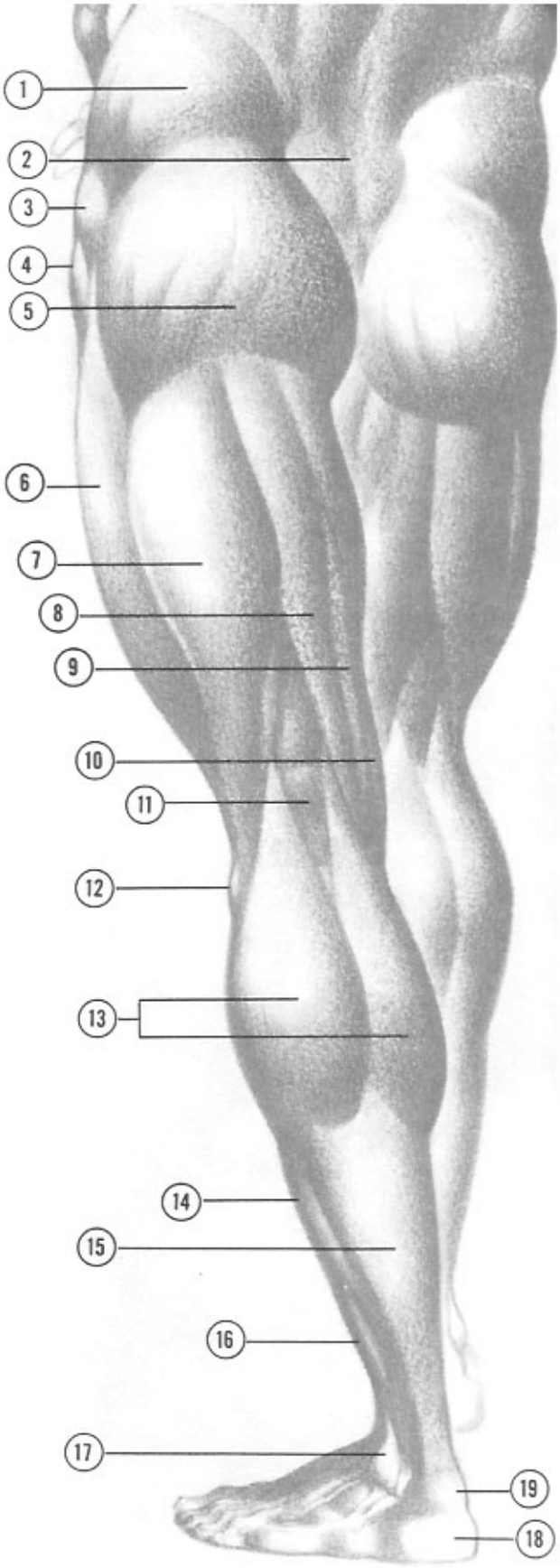





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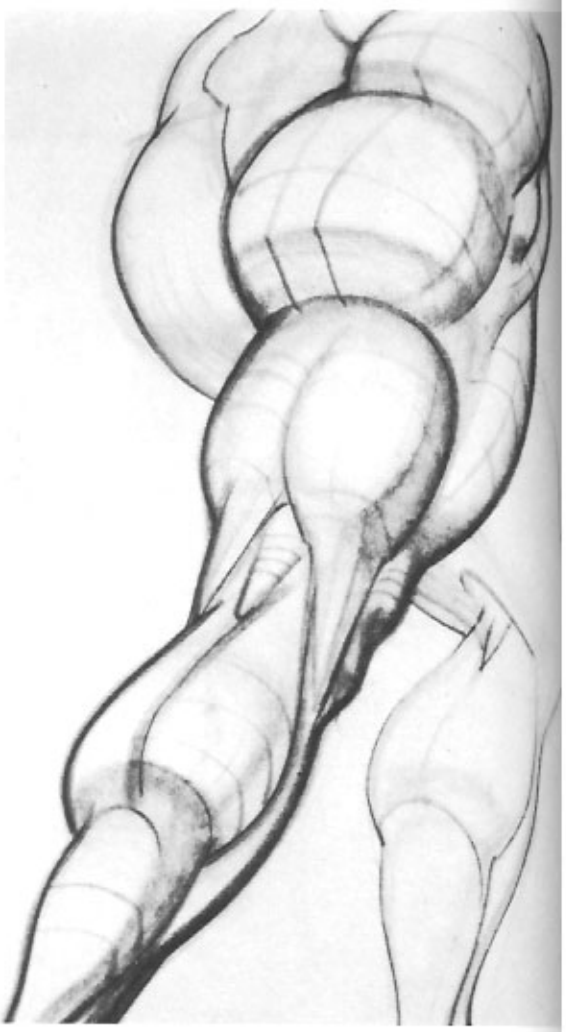
1. SACROSPINALIS
2. EXTERNUS OBLIQUE
3. GLUTEUS MEDIUS
4. SACRUM
5. GLUTEUS MAXIMUS
6. BICEPS FEMORIS
7. RECTUS FEMORIS
8. VASTUS EXTERNUS
9. FIBULA HEAD
10. GASTROCNEMIUS
11. TENDON ACHILLES
12. EXTENSOR DIGITORUM BREVIS
13. LATERAL MALLEOLUS
14. PERONEUS LONGUS
15. SOLEUS
16. TIBIALIS ANTERIOR
17. LATERAL CONDYLE – TIBIA
18. TIBIAL TUBEROSITY
19. PATELLA
20. LATERAL CONDYLE – FEMUR
21. MEDIAL MALLEOLUS
22. CALCANEUM
23. SERRATUS ANTERIOR
24. LATISSIMUS DORSI
25. ILIAC CREST
26. GREAT TROCHANTER
27. TENSOR FASCIAE LATAE
28. ADDUCTOR LONGUS
29. SARTORIUS
30. GRACILIS
31. SEMIMEMBRANOSUS
32. SEMITENDINOSUS
33. VASTUS INTERNUS
34. TIBIA

1. GLUTEUS MEDIUS
2. SACRUM
3. GREAT TROCHANTER
4. TENSOR FASCIAE LATAE
5. GLUTEUS MAXIMUS
6. VASTUS EXTERNUS
7. BICEPS FEMORIS
8. SEMITENDINOSUS
9. SEMIMEMBRANOSUS
10. GRACILIS
11. POPLITEAL FOSSA
12. FIBULA HEAD
13. GASTROCNEMIUS
14. SOLEUS
15. TENDON ACHILLES
16. PERONEUS LONGUS
17. LATERAL MALLEOLUS
18. CALCANEUM
19. BURSA



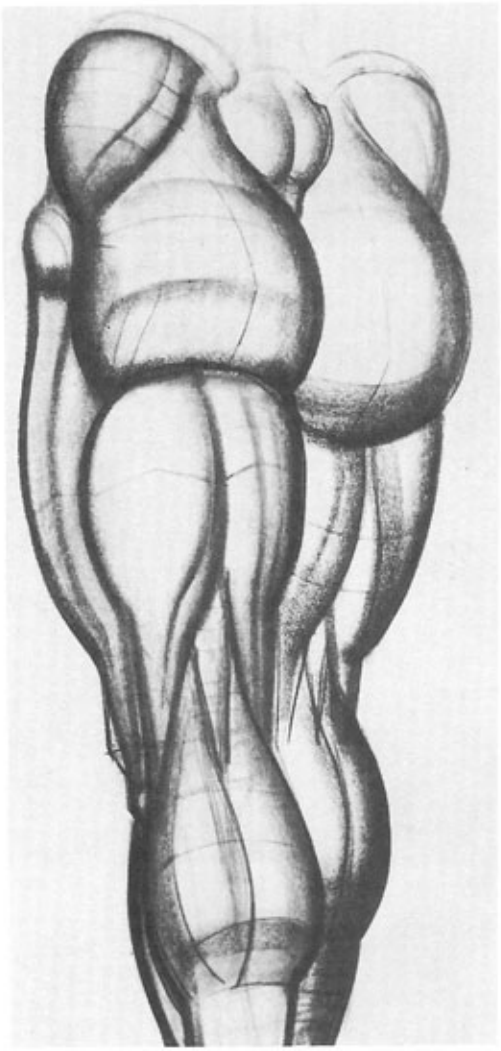


The high-low buttock line of the supporting leg and the relaxed leg.

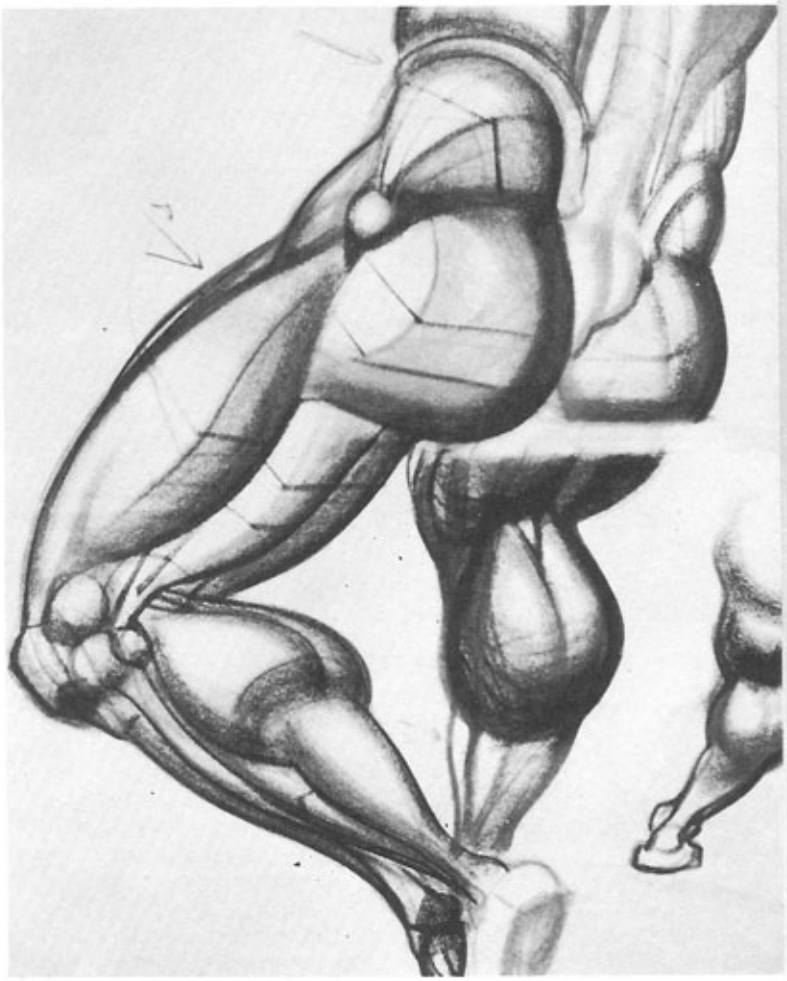


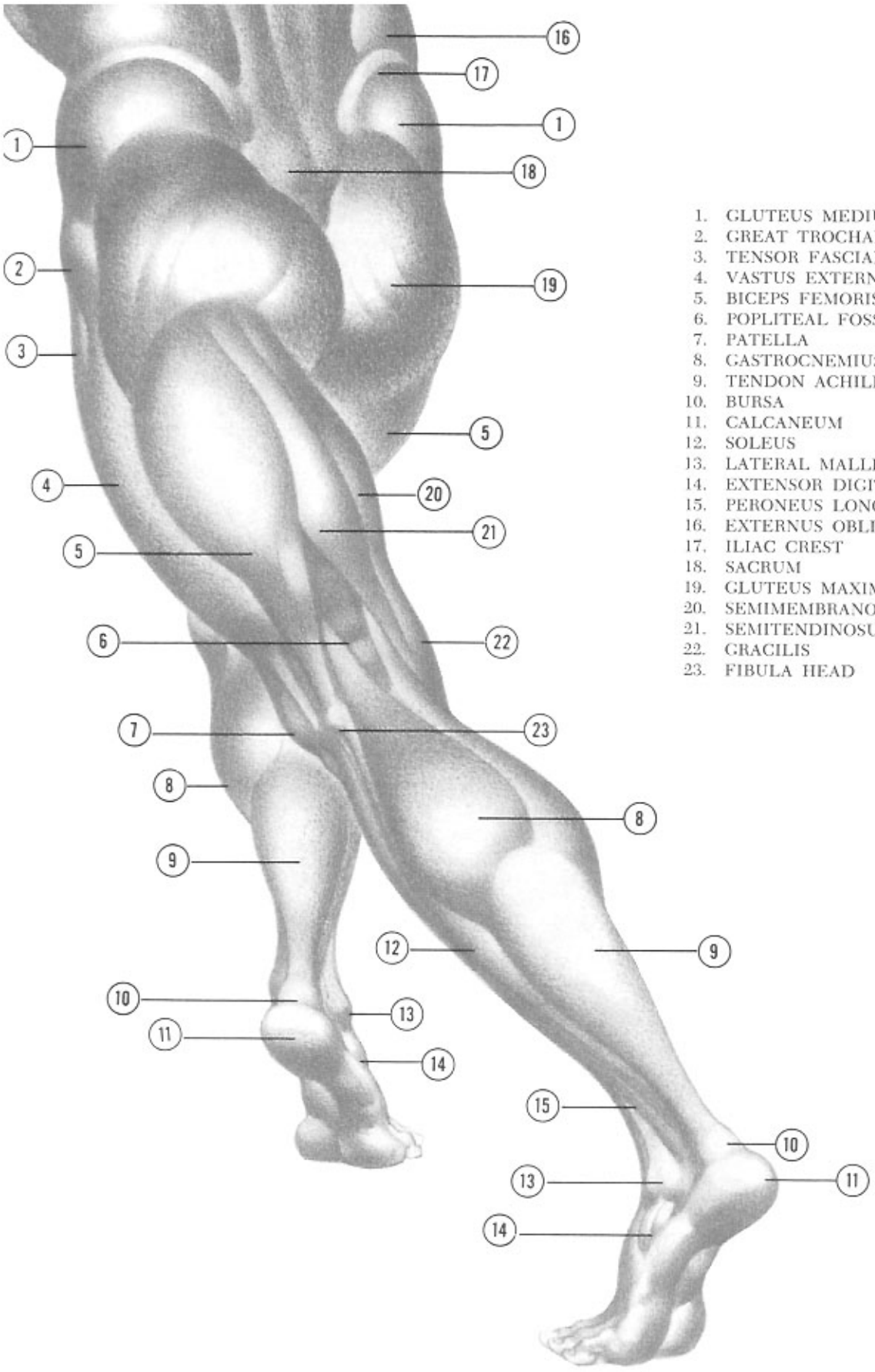
The rear view leg consists of five large masses: the two pelvic masses, gluteus medius and maximus, described earlier as the butterfly forms locked in the hip and lower spine; the middle complex of hamstring muscles, the outer biceps femoris, moving from under the buttock down to the fibula head of the outside lower leg, and the inner

hamstring group, semitendinosus, semimembranosus, and gracilis, descending to the inside tibia below the knee; then vastus internus, appearing slightly at the lower inside leg behind the hamstring tendons; finally, vastus externus, now seen partially at the broad outer contour of the back leg.

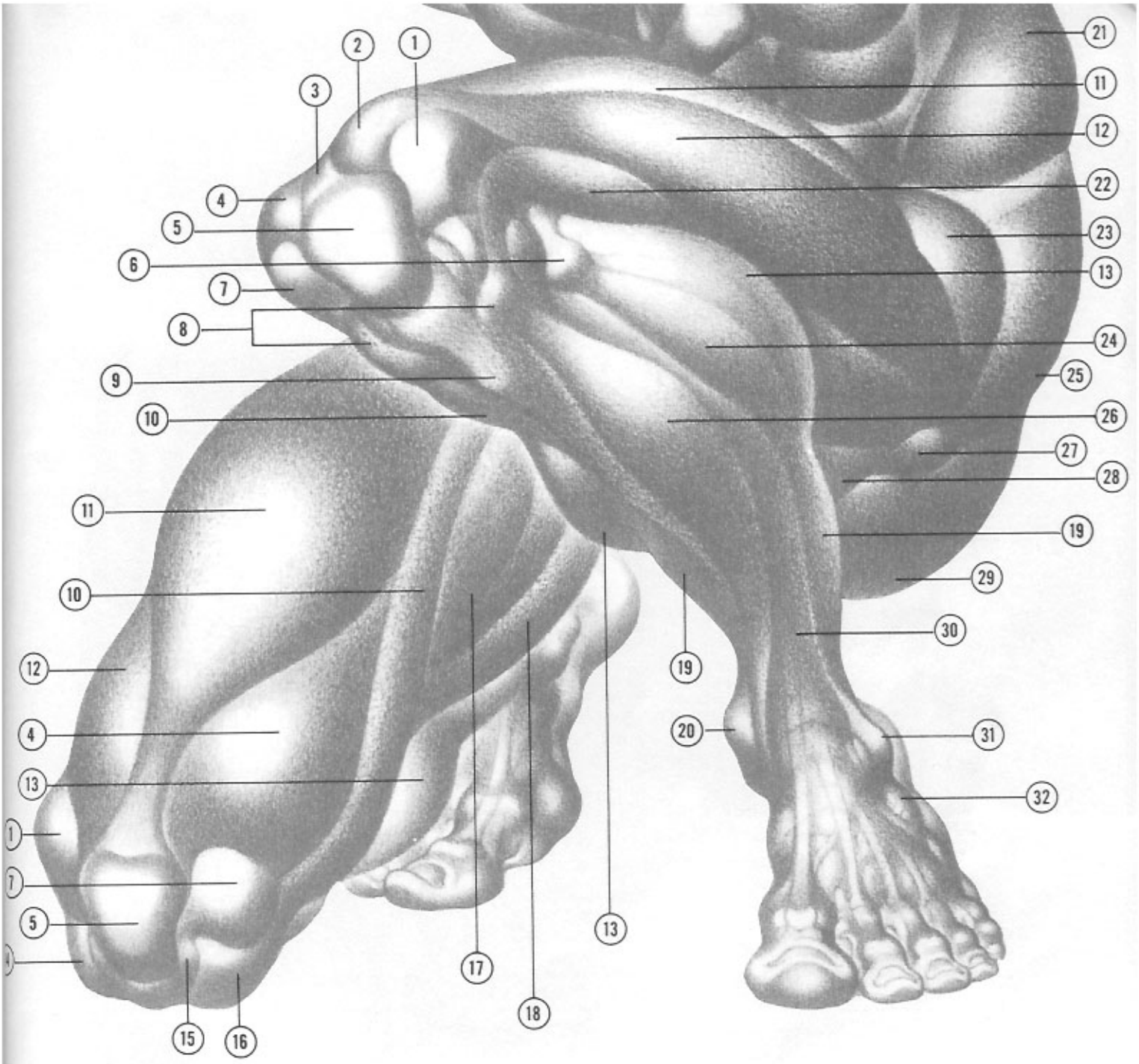


The great trochanter protrusion always lies in the side plane of the leg.

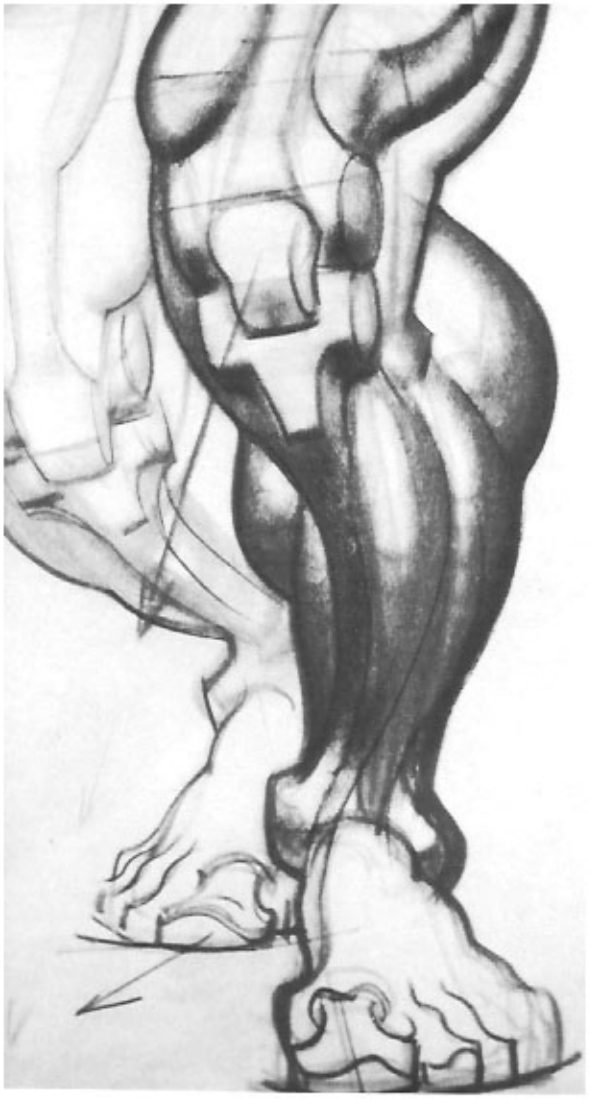




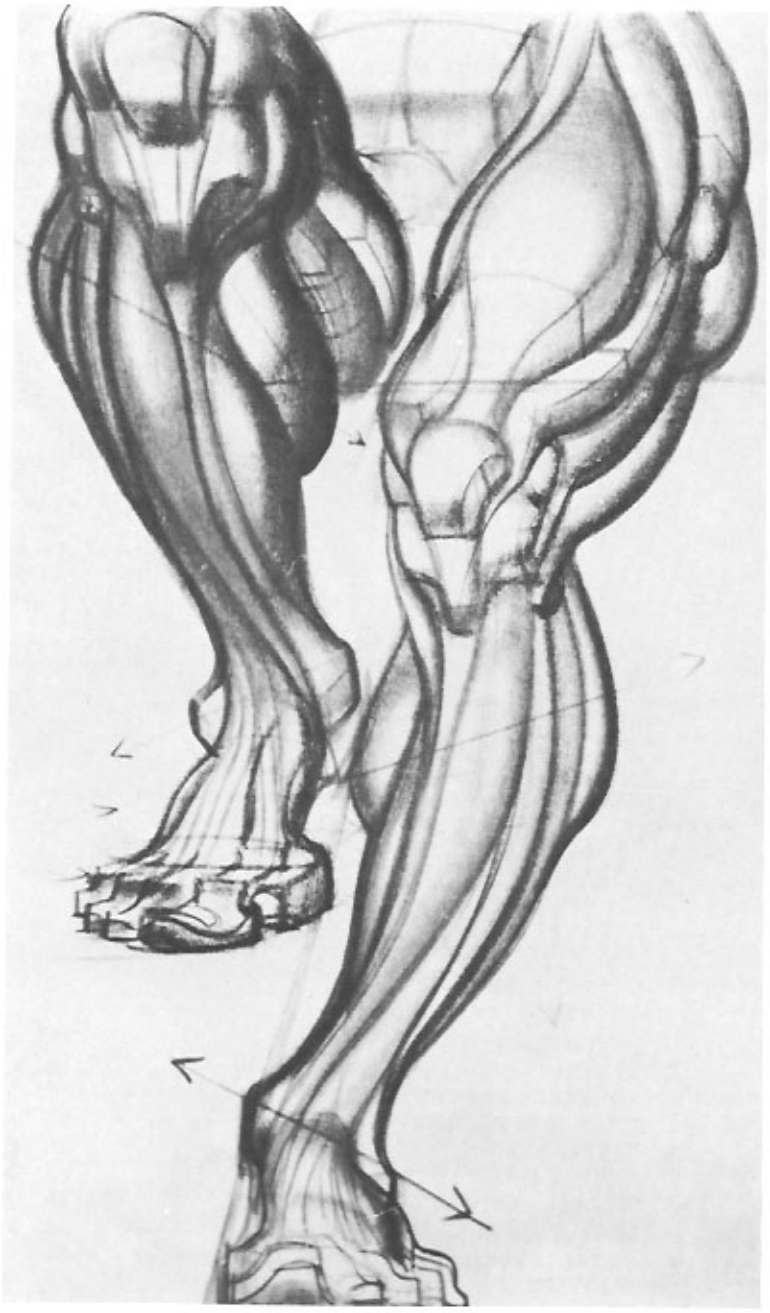
1. GLUTEUS MEDIUS
2. GREAT TROCHANTER
3. TENSOR FASCIAE LATAE
4. VASTUS EXTERNUS
5. BICEPS FEMORIS
6. POPLITEAL FOSSA
7. PATELLA
8. GASTROCNEMIUS
9. TENDON ACHILLES
10. BURSA
11. CALCANEUM
12. SOLEUS
13. LATERAL MALLEOLUS
14. EXTENSOR DIGITORUM BREVIS
15. PERONEUS LONGUS
16. EXTERNUS OBLIQUE
17. ILIAC CREST
18. SACRUM
19. GLUTEUS MAXIMUS
20. SEMIMEMBRANOSUS
21. SEMITENDINOSUS
22. GRACILIS
23. FIBULA HEAD

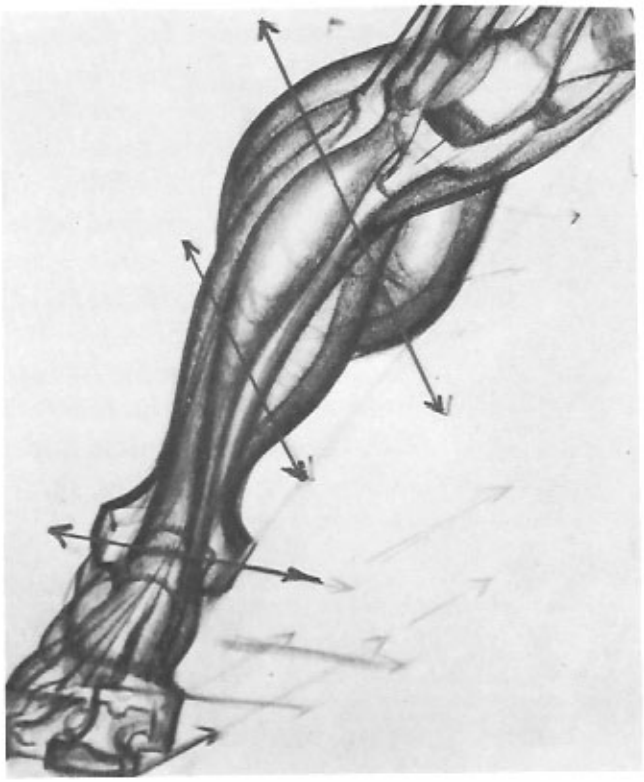


1. LATERAL CONDYLE – FEMUR
2. TENDON – VASTUS EXTERNUS
3. TENDON – RECTUS FEMORIS
4. VASTUS INTERNUS
5. PATELLA
6. FIBULA HEAD
7. MEDIAL CONDYLE – FEMUR
8. MEDIAL AND LATERAL CONDYLES – TIBIA
9. TIBIAL TUBEROSITY
10. SARTORIUS
11. RECTUS FEMORIS
12. VASTUS EXTERNUS
13. GASTROCNEMIUS
14. LATERAL CONDYLE – TIBIA
15. PATELLAR FAT
16. MEDIAL CONDYLE – TIBIA
17. ADDUCTOR LONGUS
18. GRACILIS
19. SOLEUS
20. MEDIAL MALLEOLUS
21. EXTERNUS OBLIQUE
22. BICEPS FEMORIS
23. TENSOR FASCIAE LATAE
24. PERONEUS LONGUS
25. GLUTEUS MEDIUS
26. TIBIALIS ANTERIOR
27. GREAT TROCHANTER
28. BICEPS FEMORIS
29. GLUTEUS MAXIMUS
30. EXTENSOR DIGITORUM
31. LATERAL MALLEOLUS
32. EXTENSOR DIGITORUM BREVIS



The lower leg curves decisively inward on the tibia bone line.





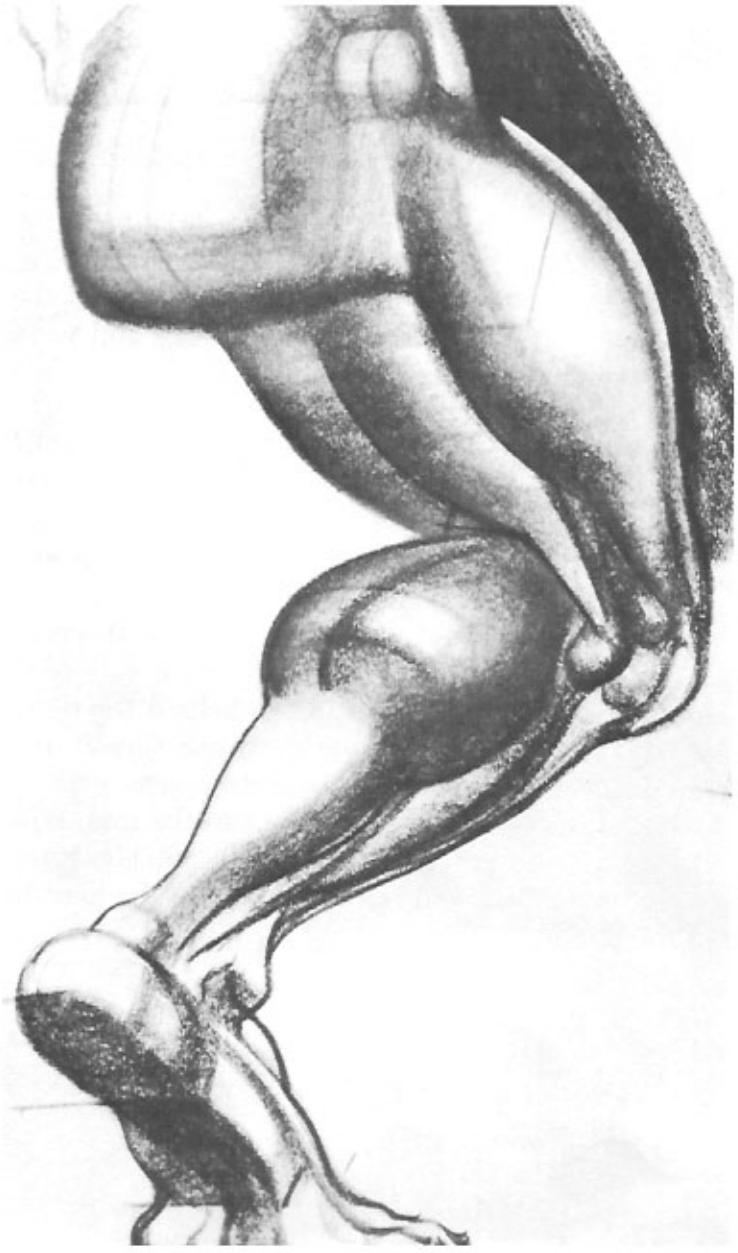
2. THE LOWER LEG MASSES. The tapered mass of the lower leg generally has an Indian club appearance, bulged and wide at the calf and quickly compressed toward the ankle. The frontal area is rather flat compared to the great bulge of the rear area.

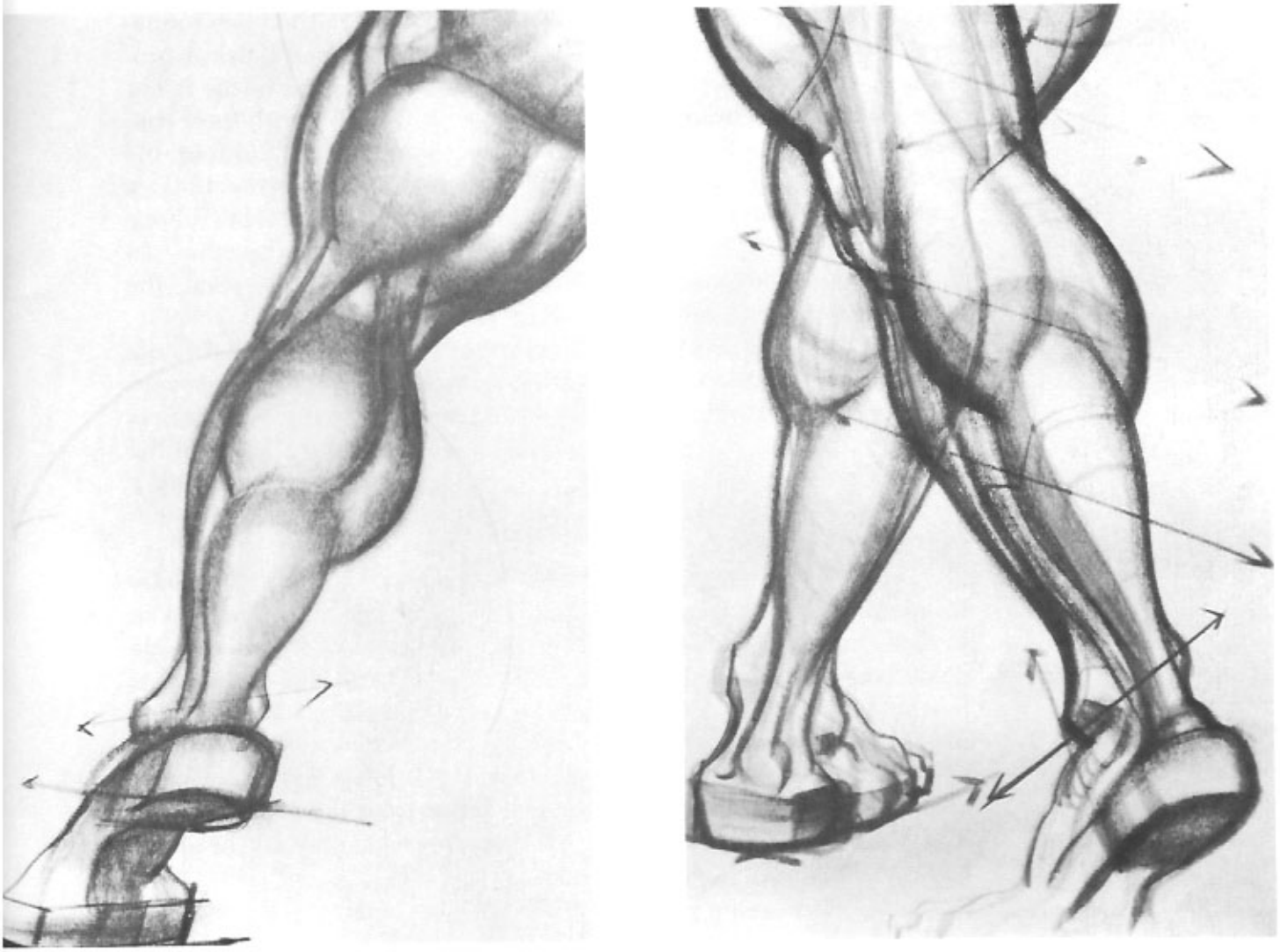
The lower leg, front view, consists of six long muscle forms: inside the tibia or shin bone, the soleus muscle appears briefly and moves downward behind the inner ankle bone into the heel; back of soleus, the inner gastrocnemius, or calf muscle, bulges from the mid-leg and passes upward to the femur condyle behind the knee; the long central muscle, tibialis anterior, starts at the high outer condyle of the tibia and drops toward the ankle to the instep of the foot; at the side edge of tibialis, peroneus moves down the leg and passes behind the outer ankle bone into the base of the foot; however, between tibialis and peroneus, a slot opens on the middle leg, and the large extensor group widens to send its tendons over the arch of the foot to the toes; now soleus reappears slightly outside peroneus; lastly, the outer gastrocnemius thrusts out from the mid-leg and rises high behind the knee to the outer condyle of the femur.



The rear view lower leg presents five masses, three large and two smaller ones. The large masses are the two great heads of the calf muscles, divided centrally and locked into the condyles of the femur base; they descend to the mid-point of the lower leg where they join their common tendon, the achilles, a mass by itself, which drops to the bursa of the calcaneum or heel bone. The two smaller masses are the soleus muscle, inner and outer, emerging from the sides of the calf muscles and passing inside the tendon to the heel.

A special note must be made of the hollow area behind the knee, the popliteal fossa, where the hamstring tendons widen to permit the calf tendons to attach to the femur. This fossa is depressed somewhat even when covered by muscle and membranous tissue. The quadrilateral hollow permits bending the leg to deep squatting positions.



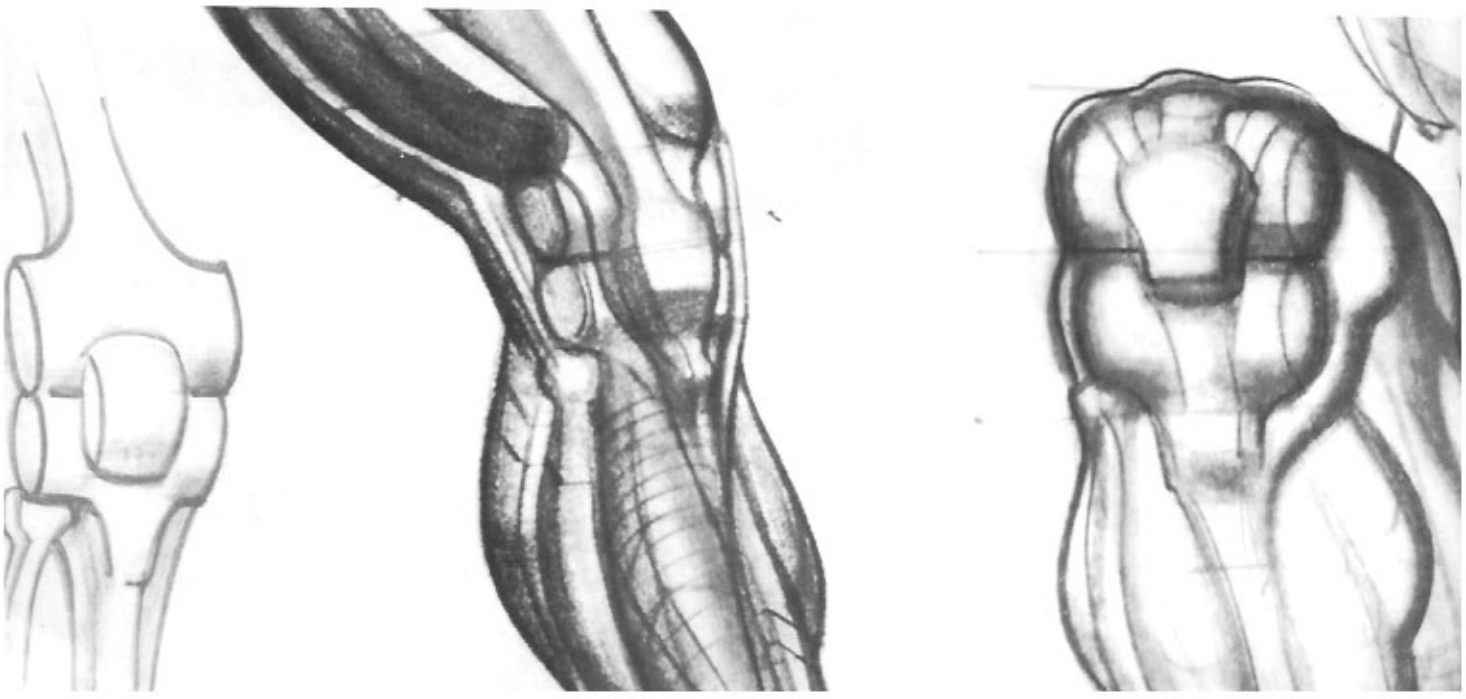


In the stance of feet, the foot line points outward from the leg line.

3. THE KNEE AND THE ANKLE. (a) The bone formation of the knee consists of seven prominences: six symmetrical protrusions and one offset protrusion. The large prominences of the femur base and the tibia head form the large box of the knee with their condyles set out at the four corners. In the center of the group of four, the patella or kneecap thrusts forward. Below the box, in the tibia, a smaller projection rises, the tibial tuberosity. Thus, a system of six bone forms appear, in a double triangular pattern, one under the other. To the lower outside position of the tibia, the seventh projection, the fibula head, develops in line with the tibial tuberosity.

(b) The ankle is a locked structure of the lower tibia and fibula and presents the appearance of a large wrench. The ankle is the powerful gripping head which holds the foot secure. The great bony projections are the inner malleolus of the tibia and the outer malleolus of the fibula. The inner ankle lies higher than the outer, thus presenting a 15-degree drop from the inside bone to the outside bone. The relationship *never* changes.

4. MEASUREMENTS. The upper leg, from trochanter to kneecap, is two heads in length. The lower leg, from kneecap to foot, is also two heads in length. The height of the foot from the inside ankle bone is one-fourth head in length. Thus, in all, the entire leg is four and one-quarter heads long. The inside contour of the upper leg mass divides at the mid-point where the adductor meets the sartorius and vastus internus. The inside contour of the lower leg also divides at the mid-position, separating the calf bulge from the soleus muscle. The buttock enters the femur in the rear upper leg one-half head below the trochanter and coccyx line.





The ankle as a wrench grips and locks the arch of the foot.



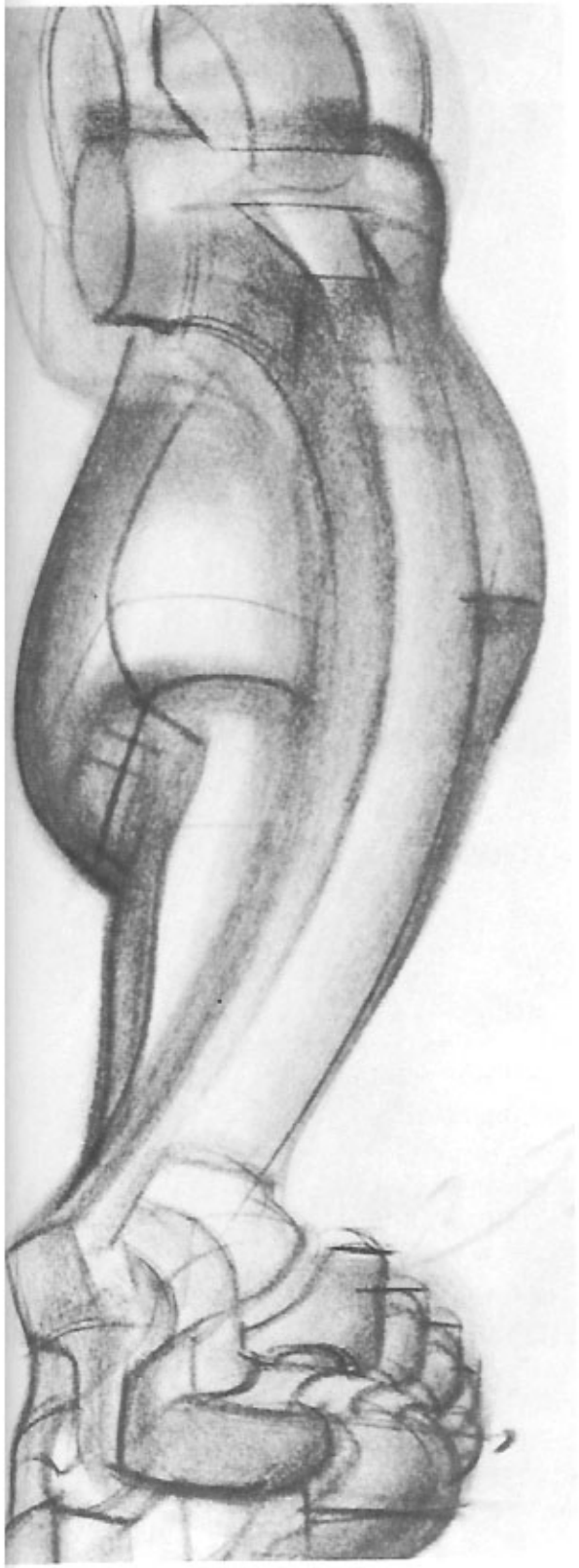


5. POINTS TO REMEMBER IN DRAWING. (a) The visual shape of the entire front view leg looks like an elongated tapered "B." The flat line of the "B" lies on the inside leg as a control line for the contours of forms which touch it. They push toward it and recede, yet almost never override the line, even in deep, foreshortened views of the front or back leg. The outer "B" identifies the tapered compressions to the knee and ankle on the coutour line.

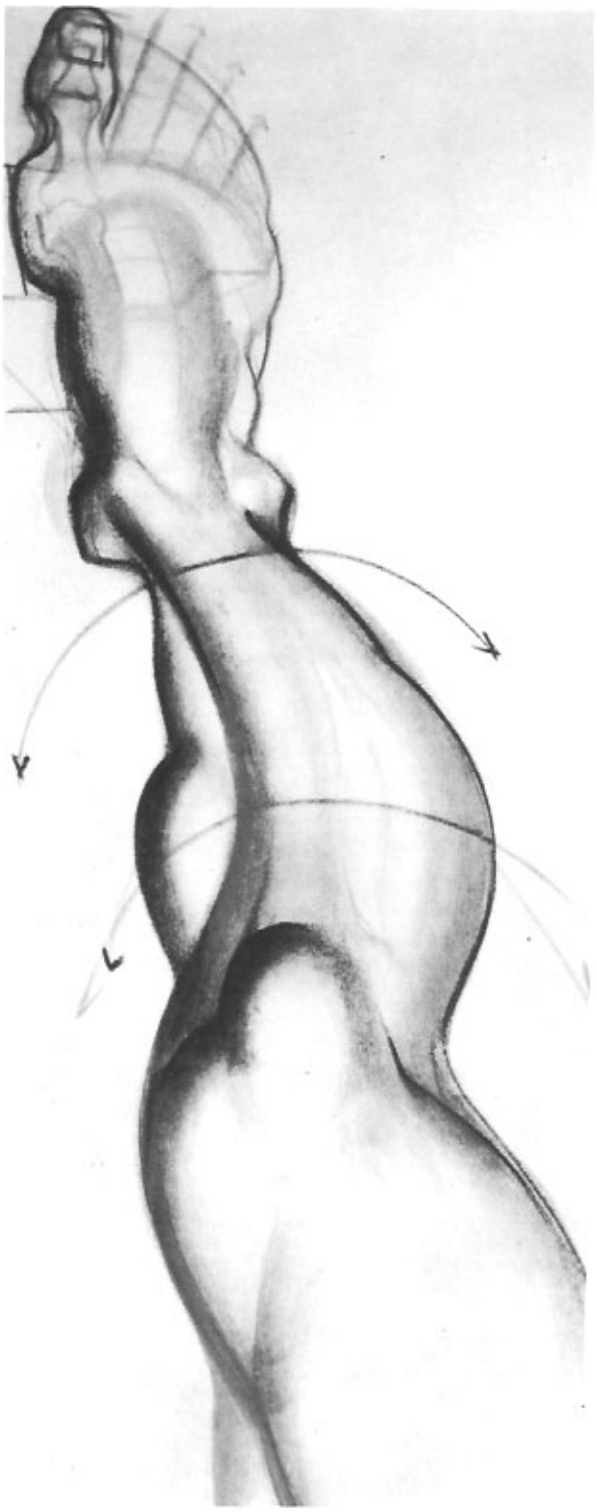
(b) The visual shape of the side-view leg is an elongated "S" line. The upper curve identifies the rectus or thigh bulge to the front, while the lower curve identifies the pouch of the calf muscle to the rear. Laying in the visual "S" first, for a side-view leg, will produce a quick natural result in drawing.

(c) The major bone of the lower leg is the tibia. It conditions the direction of the entire lower mass. It always appears to curve inward to the body line from the knee to the ankle, front view. To straighten this line will make the leg look like a piece of pipe, unnatural and grotesque.

(d) Study all the muscle masses of the outside leg contour with respect to the masses of the inside leg contour. The outside masses are higher across a corresponding group of the inside contour. The line of relationship drops from the high outside forms to the lower inside forms along the entire length of the leg. Observe the position of the calf masses outside and inside. See the positions of vastus externus and internus. They follow the pattern of angled descent, as do all the others. This pattern continues until the ankle is reached, and here the angle relationship is reversed on the bones. The drawing must show these interrelationships no matter how well the anatomy is defined.



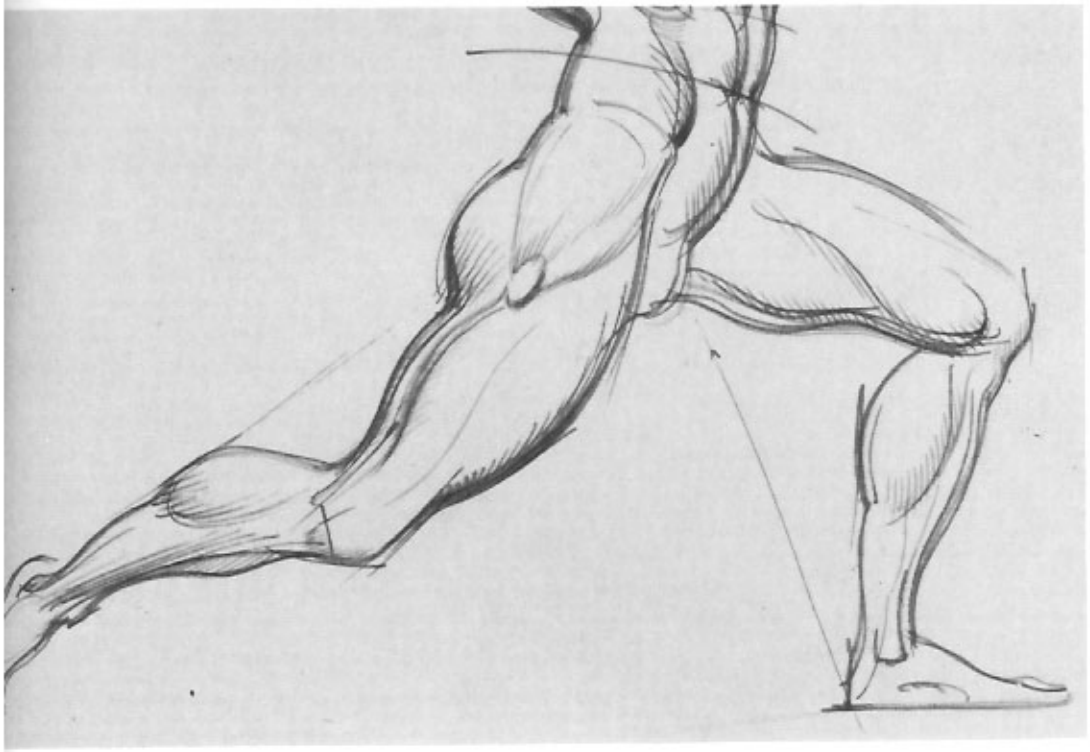




The bow line of the leg, the sartorius-tibia channel.

The trochanter-ankle vertical relationship in the deep squatting position of the leg.

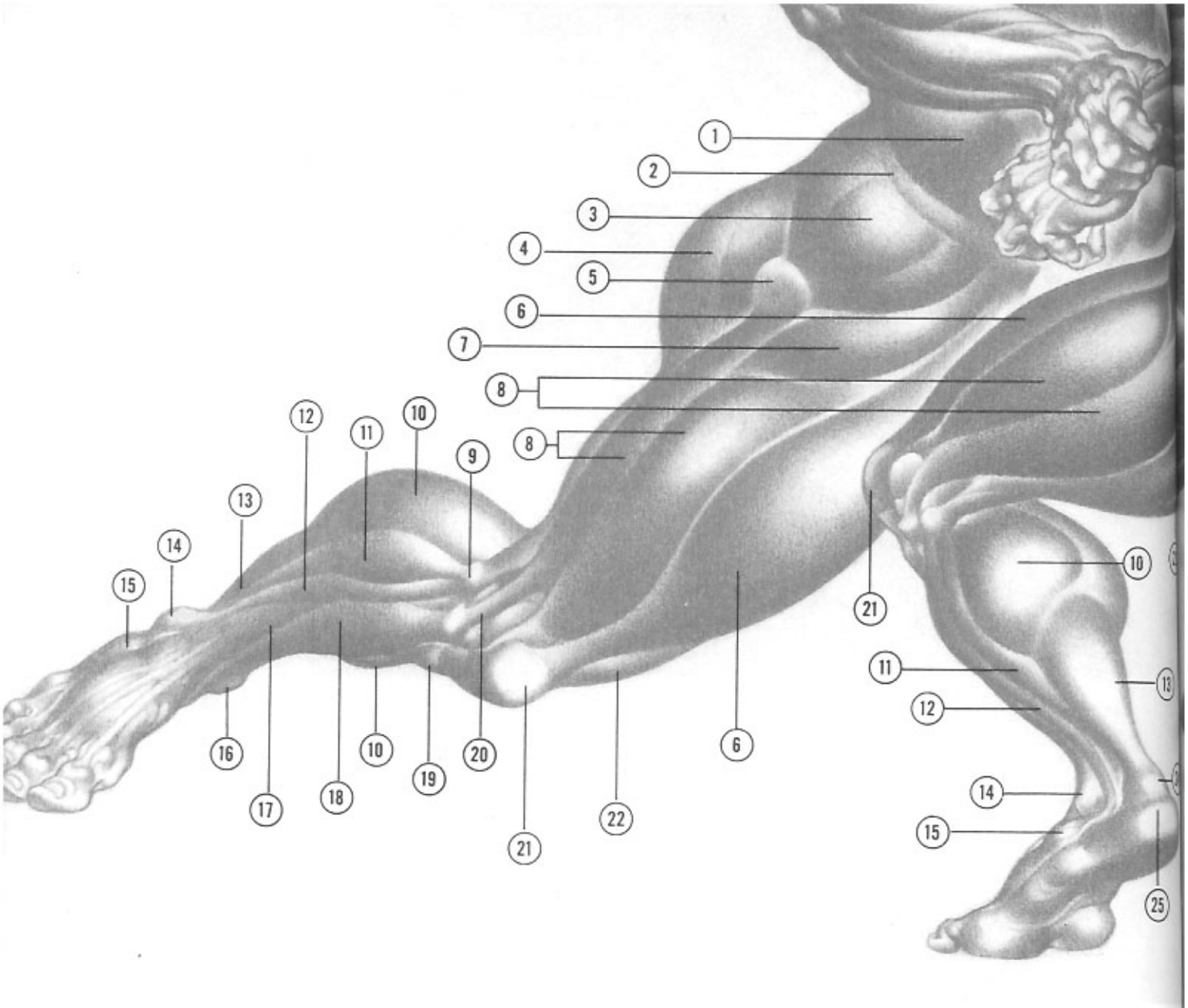




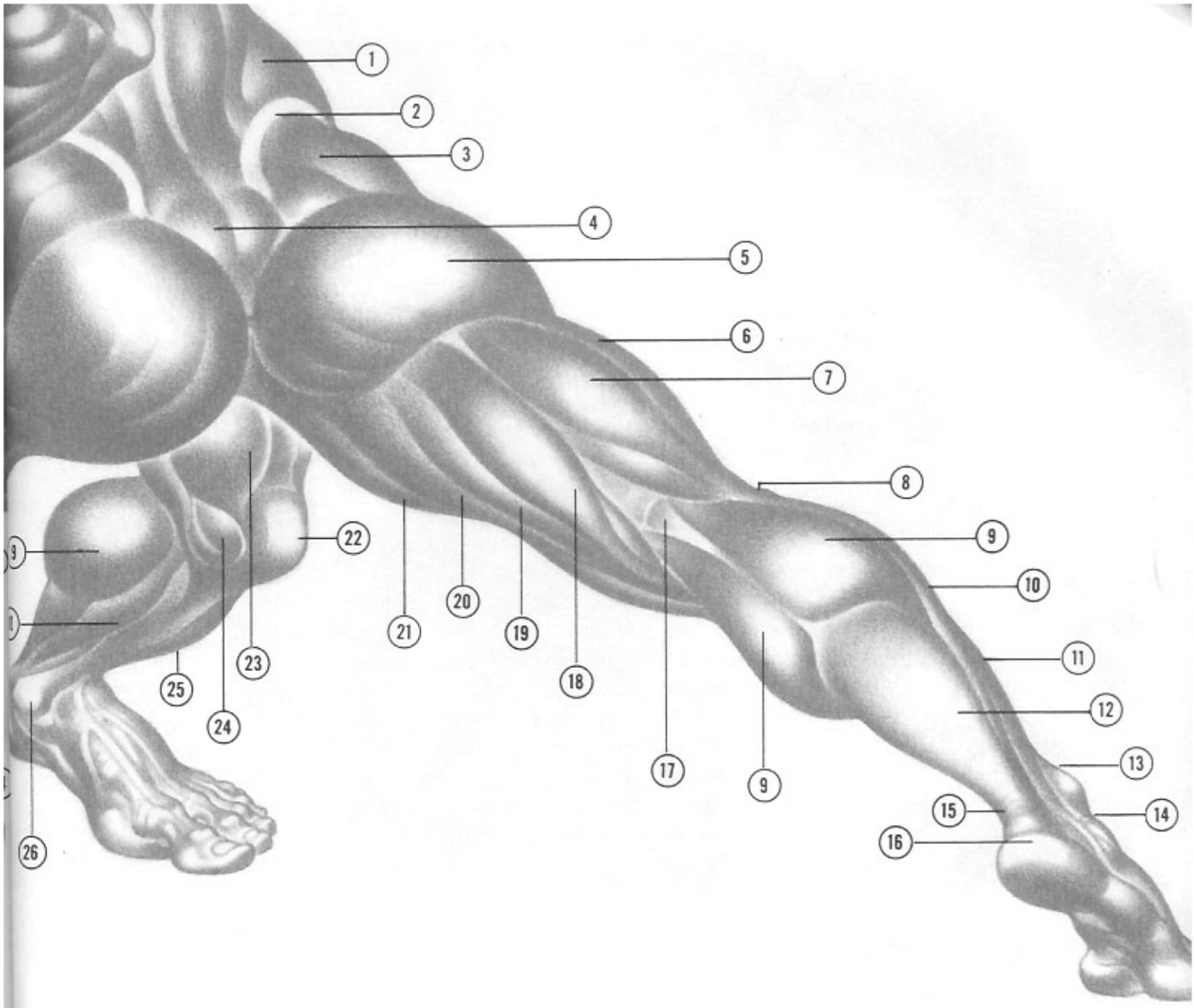
The isosceles triangulation of the legs in movement.

(e) A great bow, like that of an archer, appears as a visual pattern of movement down the entire front leg. It can be seen to start at the hip front, move along the sartorial channel, swing around the inside knee, curve on the tibia channel to the ankle. This line will help form the major inside contour of the leg, and will aid in muscle placement.

(f) When the leg bends to a deep squatting position, the trochanter and outer ankle bone lie one under the other. The heel is pressed against the buttock, and the base line of the foot can be seen to curve onto the curve of the buttock line. In deep views of the leg in this position, these check points will establish correct placement of the lengths of leg. Now, observe carefully: As the leg opens, first slightly, then wider, the equal lengths of upper and lower leg form a series of isosceles triangles, that is, equal-sided triangles, when the trochanter and ankle bones are connected with a line. This device will establish correctly the lengths of leg in any position in drawing. The device can be used for the arm as well.



1. EXTERNUS OBLIQUE
2. ILIAC CREST
3. GLUTEUS MEDIUS
4. GLUTEUS MAXIMUS
5. GREAT TROCHANTER
6. RECTUS FEMORIS
7. TENSOR FASCIAE LATAE
8. VASTUS EXTERNUS
9. FIBULA HEAD
10. GASTROCNEMIUS
11. SOLEUS
12. PERONEUS LONGUS
13. TENDON ACHILLES
14. LATERAL MALLEOLUS
15. EXTENSOR DIGITORUM BREVIS
16. MEDIAL MALLEOLUS
17. EXTENSOR DIGITORUM
18. TIBIALIS ANTERIOR
19. TIBIAL TUBEROSITY
20. ILIOTIBIAL BAND
21. PATELLA
22. VASTUS INTERNUS
23. BICEPS FEMORIS
24. BURSA
25. CALCANEUM



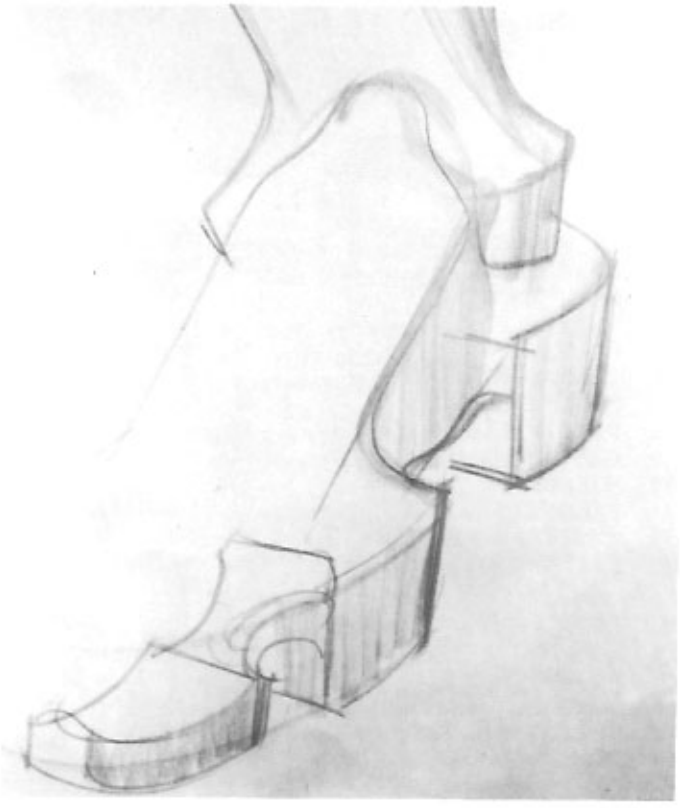
1. EXTERNUS OBLIQUE
2. ILIAC CREST
3. GLUTEUS MEDIUS
4. SACRUM
5. GLUTEUS MAXIMUS
6. VASTUS EXTERNUS
7. BICEPS FEMORIS
8. FIBULA HEAD
9. GASTROCNEMIUS
10. SOLEUS
11. PERONEUS LONGUS
12. TENDON ACHILLES
13. LATERAL MALLEOLUS
14. EXTENSOR DIGITORUM BREVIS
15. BURSA
16. CALCANEUM
17. POPLITEAL FOSSA
18. SEMITENDINOSUS
19. SEMIMEMBRANOSUS
20. GRACILIS
21. ADDUCTOR LONGUS
22. PATELLA
23. VASTUS INTERNUS
24. MEDIAL CONDYLE – FEMUR
25. TIBIALIS ANTERIOR
26. MEDIAL MALLEOLUS

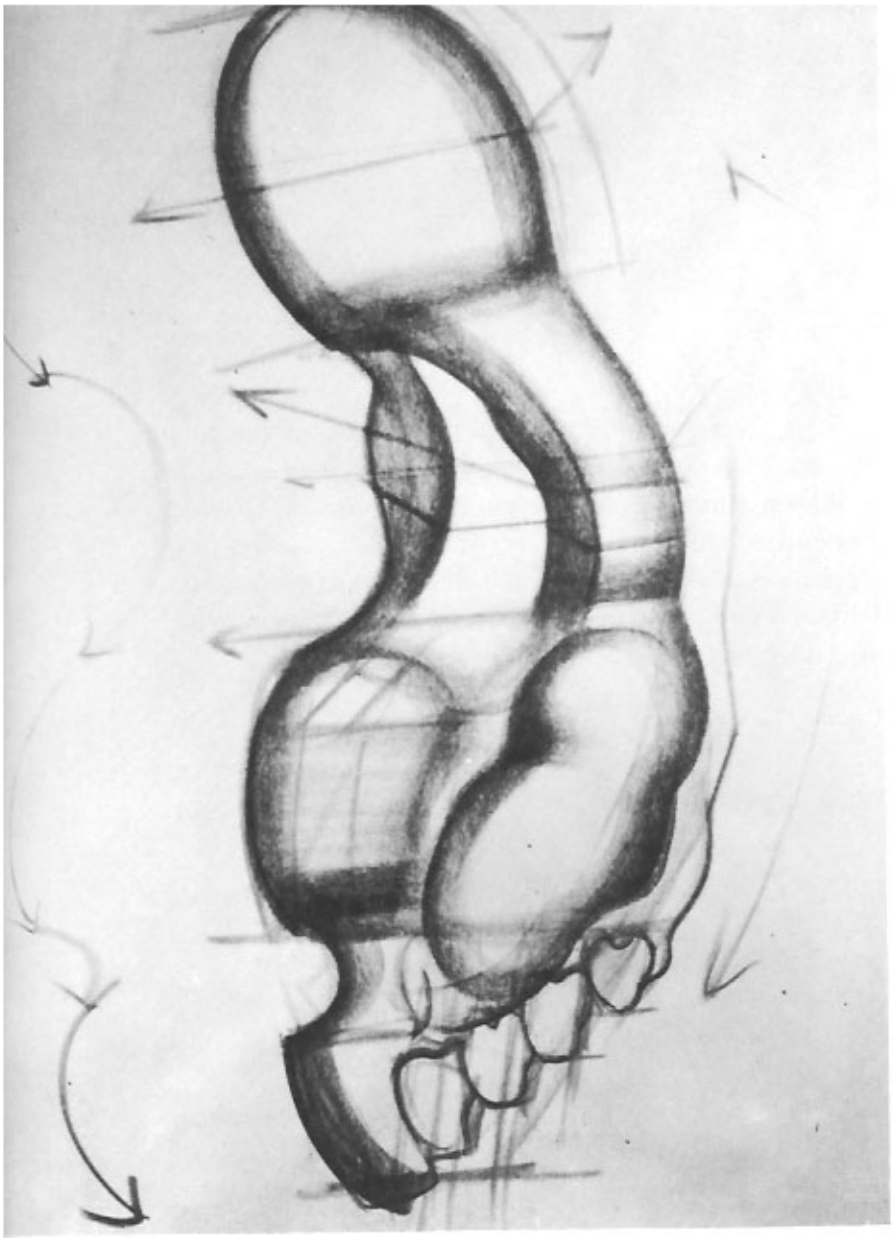
THE FOOT

1. THE MASSES OF THE FOOT. There are three major masses in the foot: the heel platform; the arch; and the front platform, the sole, which is divided in half to form the front and middle soles of the foot. The heel and middle sole provide a pedestal base for the column of the figure, while the arch acts as a spring device to absorb pressure shock to the body. The front sole of the toes acts as a gripping and pushing device in walking and running.

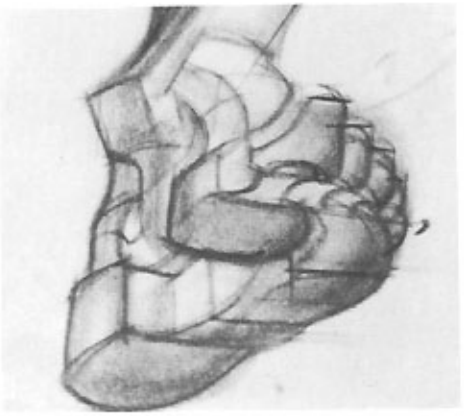
The top of the foot is quite hard and bony, with the arch distinctly extruded from the base. The outer form on the sole of the foot contacts ground surface along the entire length from heel to toes. The inner foot touches surface mainly at the toe and heel, with the instep arch off the ground. Thus, with the feet together, an elliptical pediment is formed, with a hollow center area to support the body column.

The sole of the foot, padded and cushioned, consists of four generalized masses: the calcaneum or heel; the outer ridge of padded muscle, the abductors, from heel to the little toe; the large cushioned mass of lumbricals and short flexors grouped behind the four toes; the large padded bulge behind the hallucis or great toe. The instep is high and cushioned, and under its surface, the long abductor group spans the foot length from the great toe to the heel.



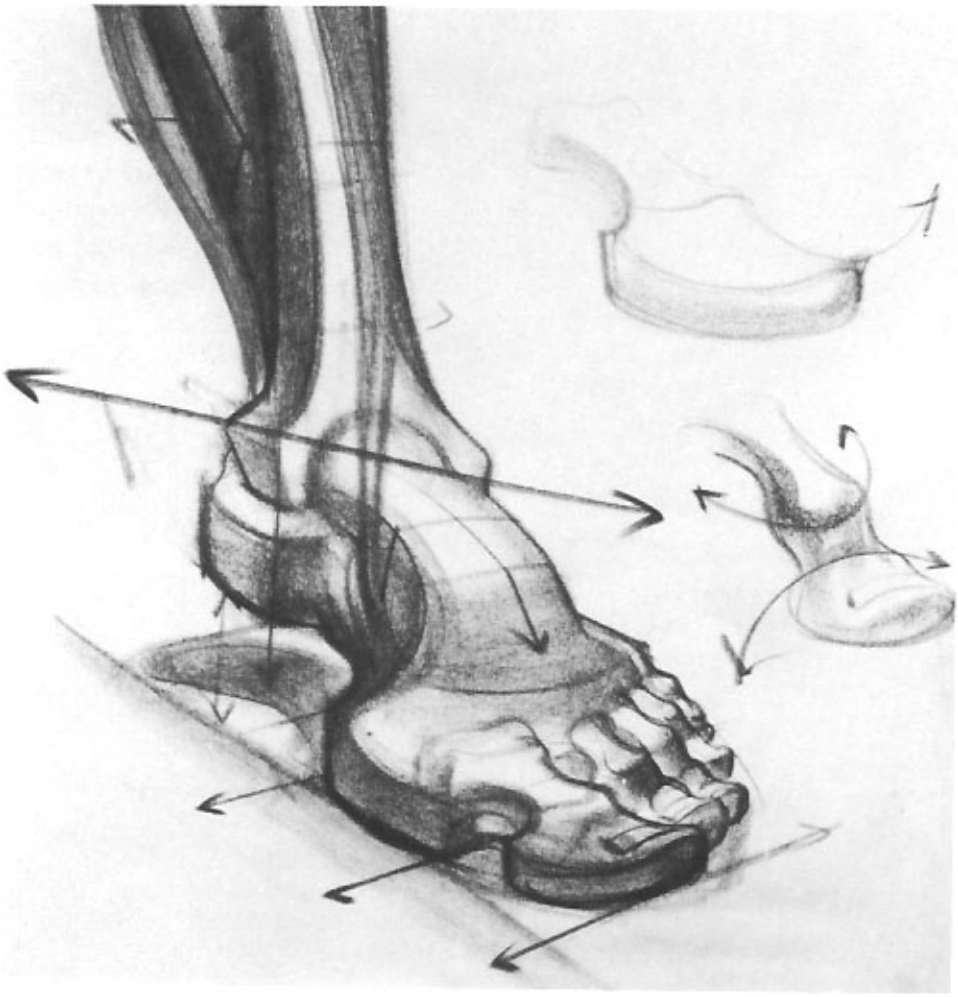


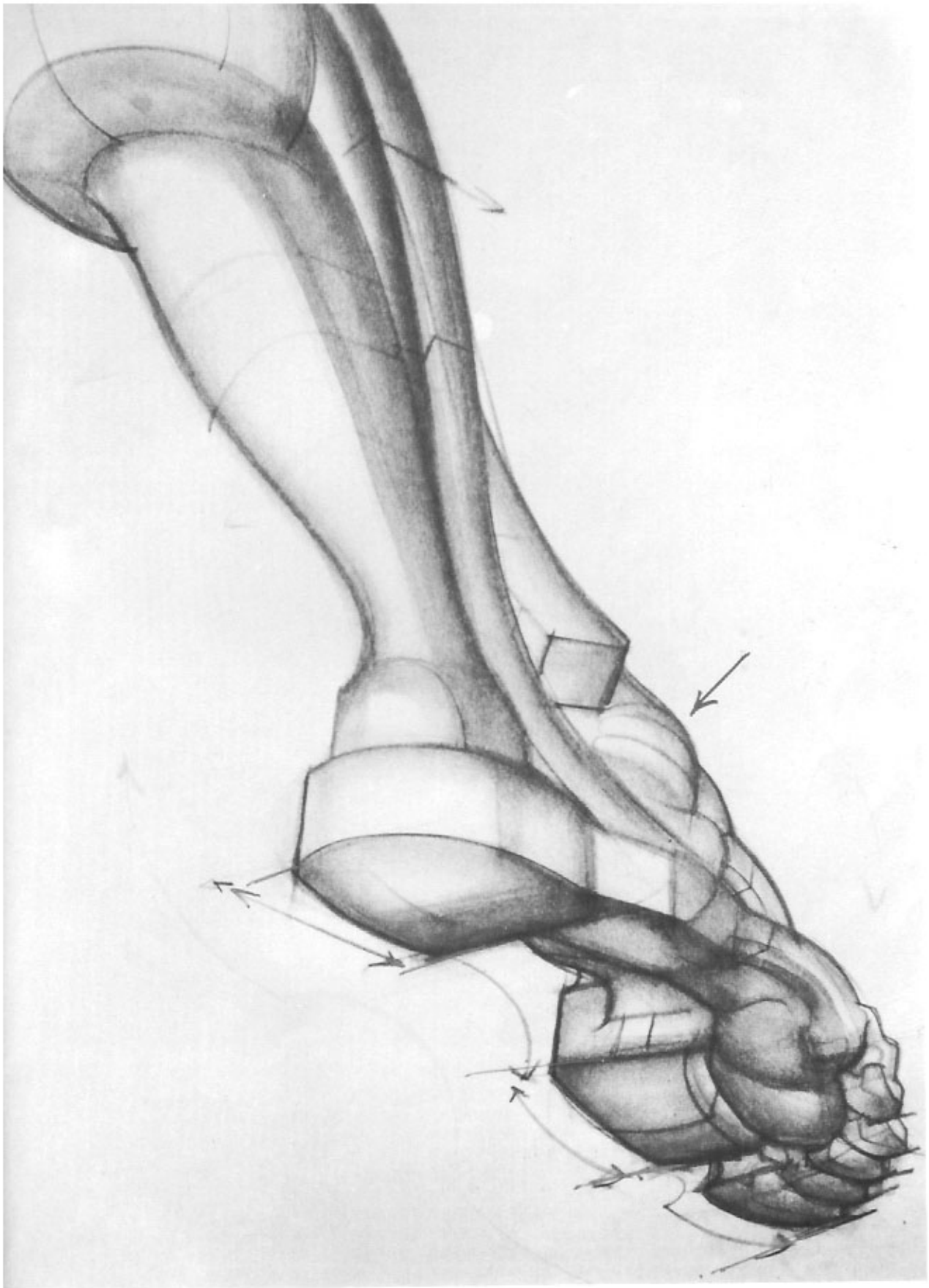
Carving the arch and instep establishes the vertical and horizontal planes of the foot.

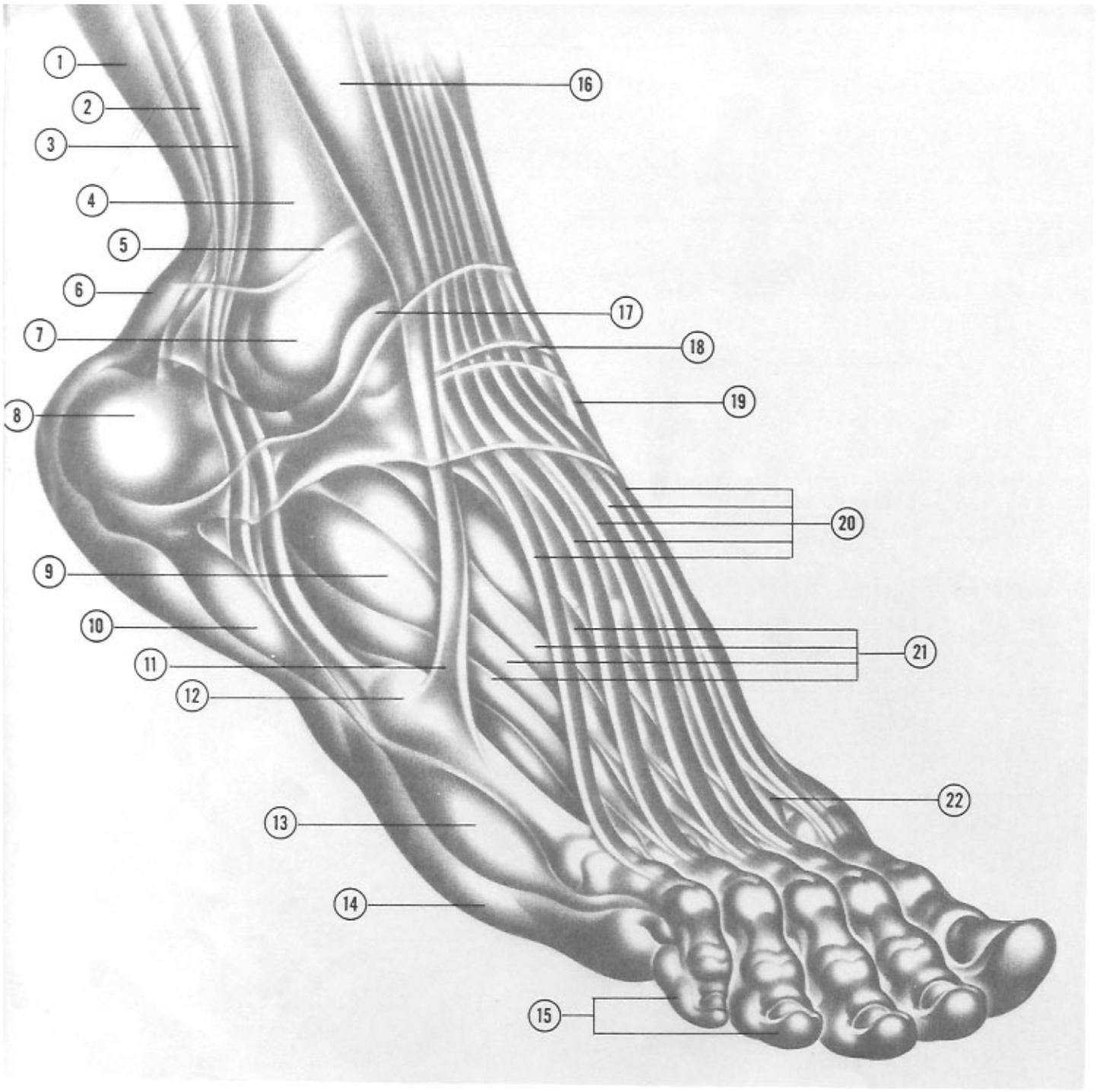


The locked arch in the wrench of the ankle consists of the tarsal bones. The major bone here is the talus, a saddle of bone protruding from the wrench, which starts the arch over which the ramp of extensor tendons descend to the toes.

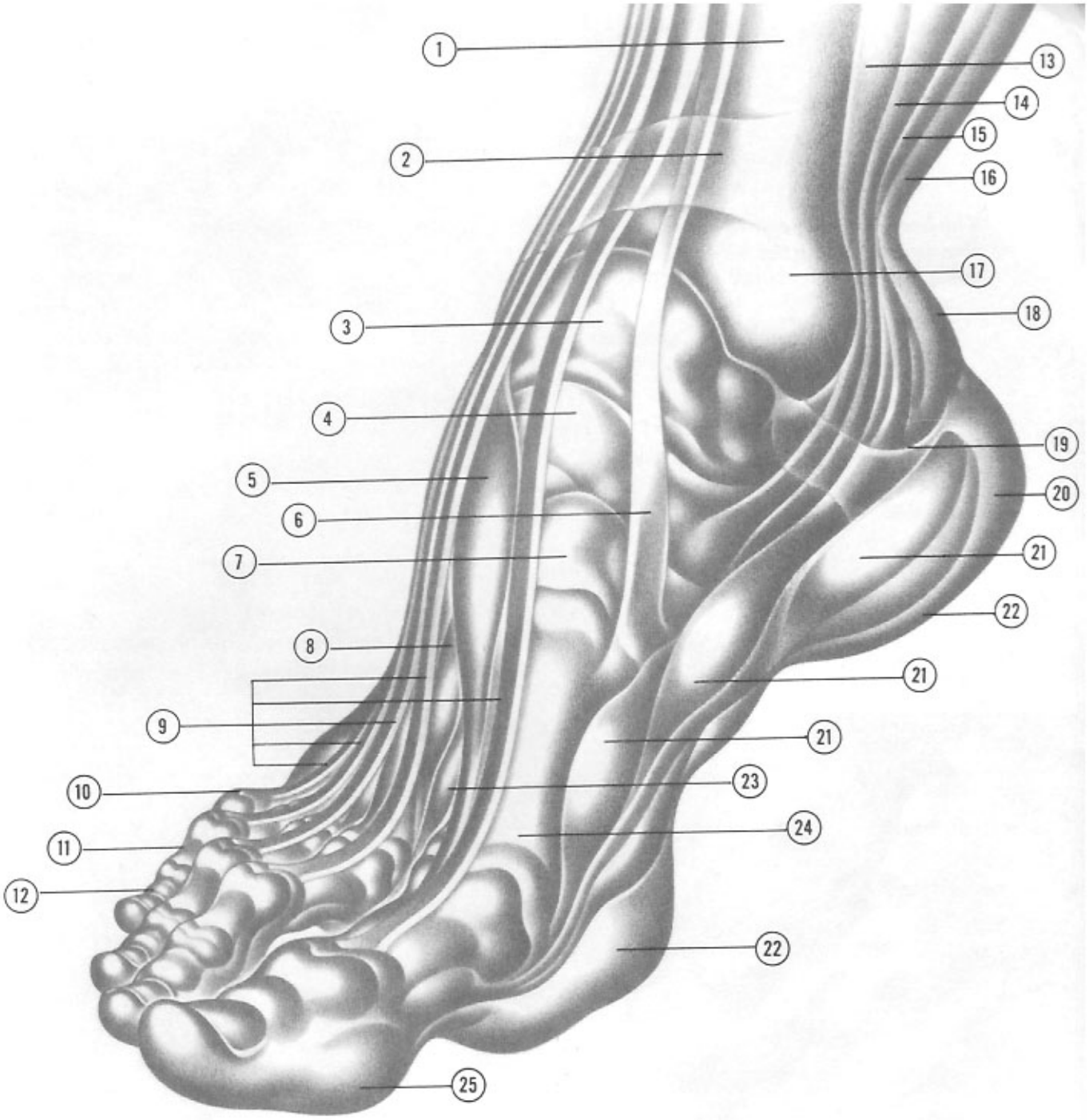
A small muscle mass located on the outer side of the arch, just front of the ankle bone, may be observed. This is the small extensor muscle group, virtually the only muscle mass visible on the top foot.





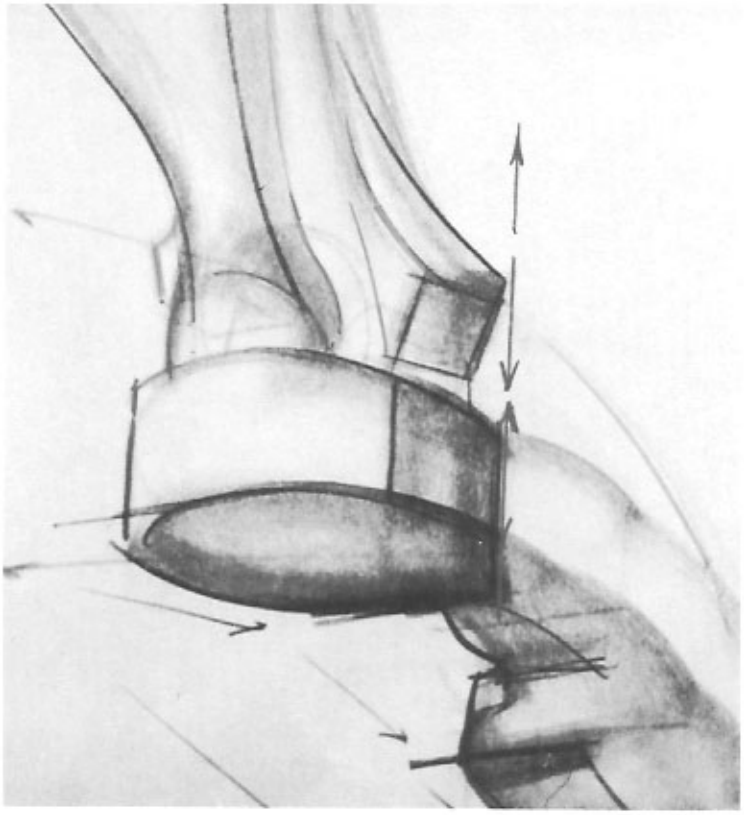


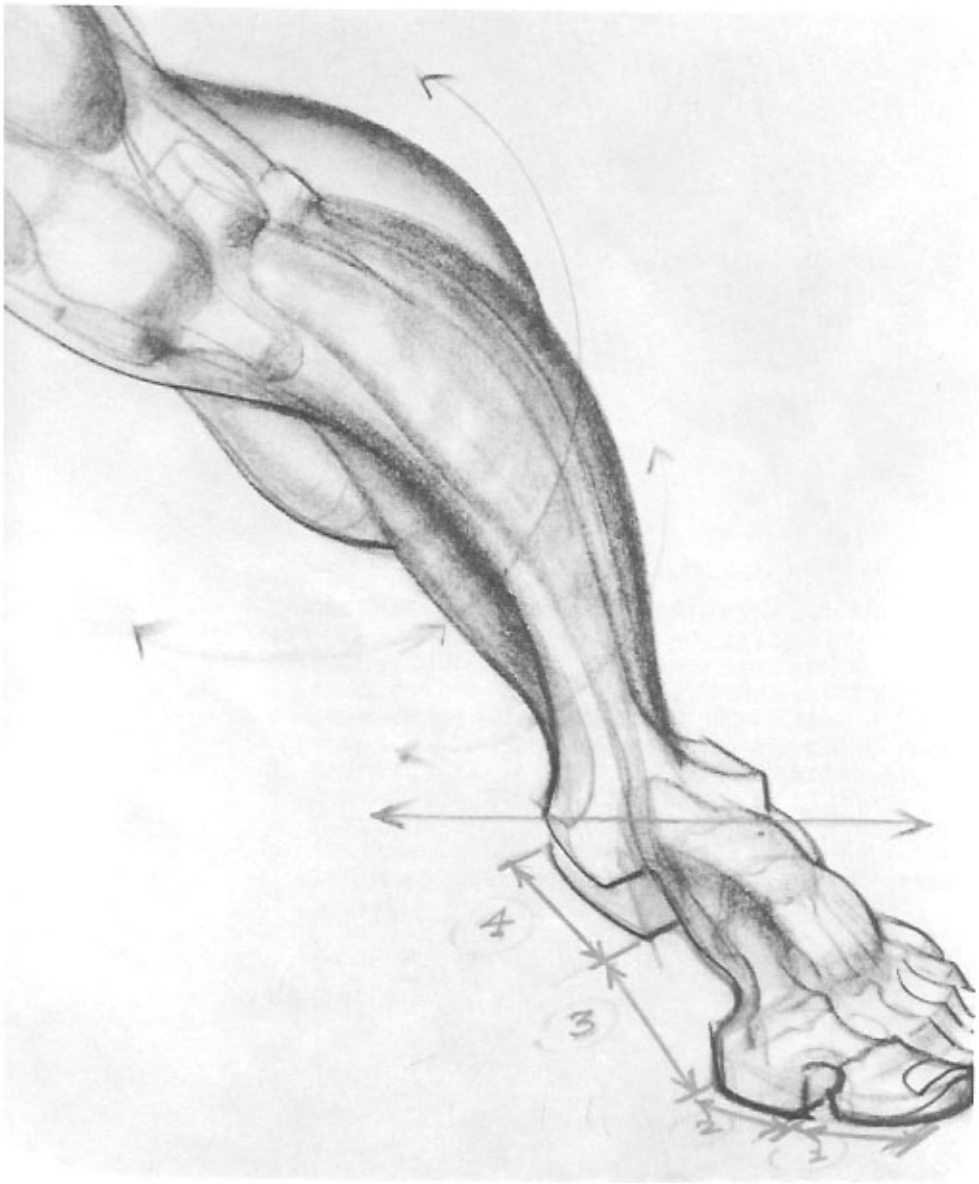
1. TENDON ACHILLES
2. PERONEUS BREVIS
3. PERONEUS LONGUS
4. FIBULA BONE
5. TRANSVERSE LIGAMENT
6. BURSA
7. LATERAL MALLEOLUS
8. CALCANEUM
9. EXTENSOR DIGITORUM BREVIS
10. ABDUCTOR DIGITI QUINTI
11. TENDON – PERONEUS TERTIUS
12. FIFTH METATARSAL
13. ABDUCTOR DIGITI QUINTI
14. SOLE PAD
15. TOE PADS
16. PERONEUS TERTIUS
17. TALUS TARSAL BONE
18. CRUCIATE LIGAMENT
19. TENDON – TIBIALIS ANTERIOR
20. TENDONS – EXTENSOR DIGITORUM
21. TENDONS – EXTENSOR DIGITORUM BREVIS
22. INTEROSSEUS



1. TIBIA BONE
2. TRANSVERSE LIGAMENT
3. TALUS TARSAL BONE
4. NAVICULAR TARSAL BONE
5. EXTENSOR HALLUCIS BREVIS
6. TENDON – TIBIALIS ANTERIOR
7. CUNEIFORM TARSAL BONE (1)
8. INTEROSSEUS
9. TENDONS – EXTENSOR DIGITORUM
10. PROXIMAL PHALANX (I)
11. MEDIAN PHALANX (II)
12. TERMINAL PHALANX (III)
13. FLEXOR DIGITORUM LONGUS
14. FLEXOR HALLUCIS LONGUS
15. SOLEUS
16. TENDON ACHILLES
17. MEDIAL MALLEOLUS
18. BURSA
19. LACINIATE LIGAMENT
20. CALCANEUM
21. ABDUCTOR HALLUCIS
22. SOLE PAD
23. INTEROSSEUS
24. FIRST METATARSAL
25. TOE PAD

The heel position begins on a line directly below the ankle bone.





2. MEASUREMENTS. The length of the foot is the length of the *forearm*. In another context, it is one head and a third in length. The width of the foot, from the big toe to the little toe is a half-head wide.

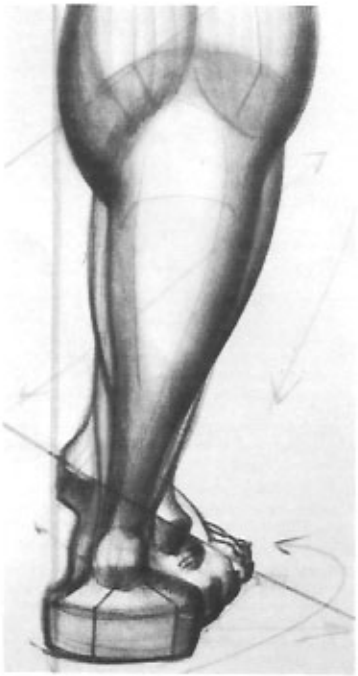
The length of the foot divides into four equal sections: (a) the heel, from back to front; (b) the instep; (c) the ball of the big toe; (d) the big toe, both phalanges.

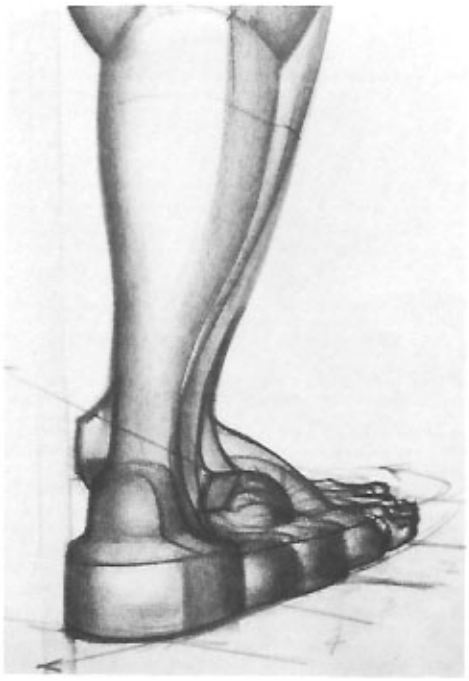
The ankle joins the foot at a vertical point over the front of the heel. Its height at the inner ankle bone is equal to the length of the heel, or one-fourth the length of the foot. The smallest toe on the outside foot *ends* at the line drawn across the beginning of the big toe.





The stance of feet, front and rear views.

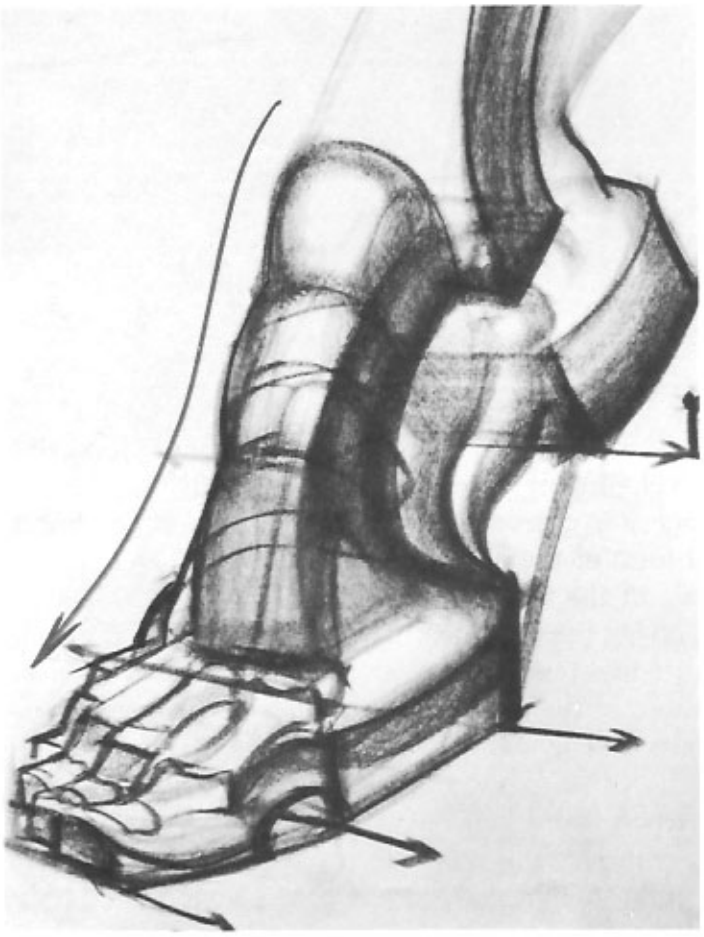


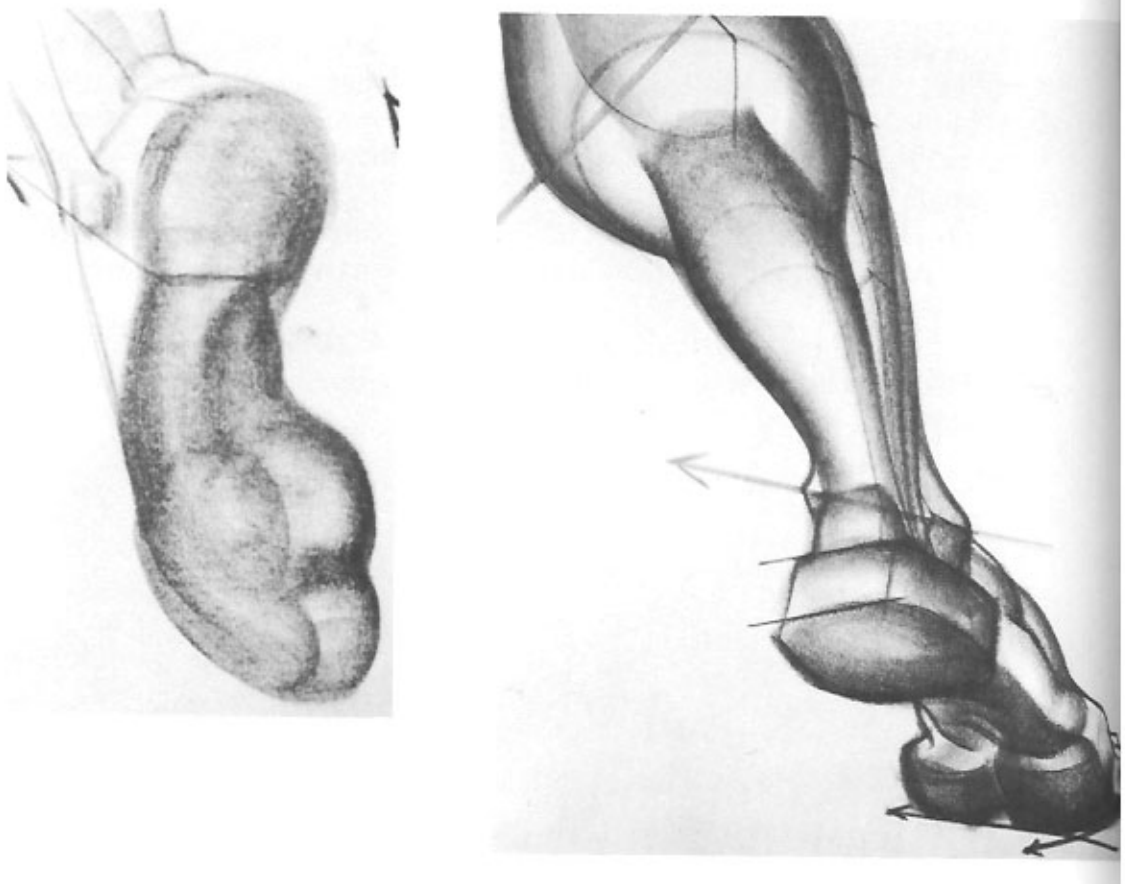


3. POINTS TO REMEMBER IN DRAWING. (a) The *stance of feet* almost invariably points off the center body line. As the legs thrust inward to the center, the foot reverses the direction and points outward. With the heels together, the toes point out to form a 50-degree angle; at the extreme position, they may form a 90-degree angle.

(b) In drawing the foot, remember to *carve the arch* and the *instep* immediately. This will locate major forms of the foot for later refinement.

(c) The top of the foot forms a long ski slide from arch to toes. Place this line first, in order to define the rhythm movement of the top surface.



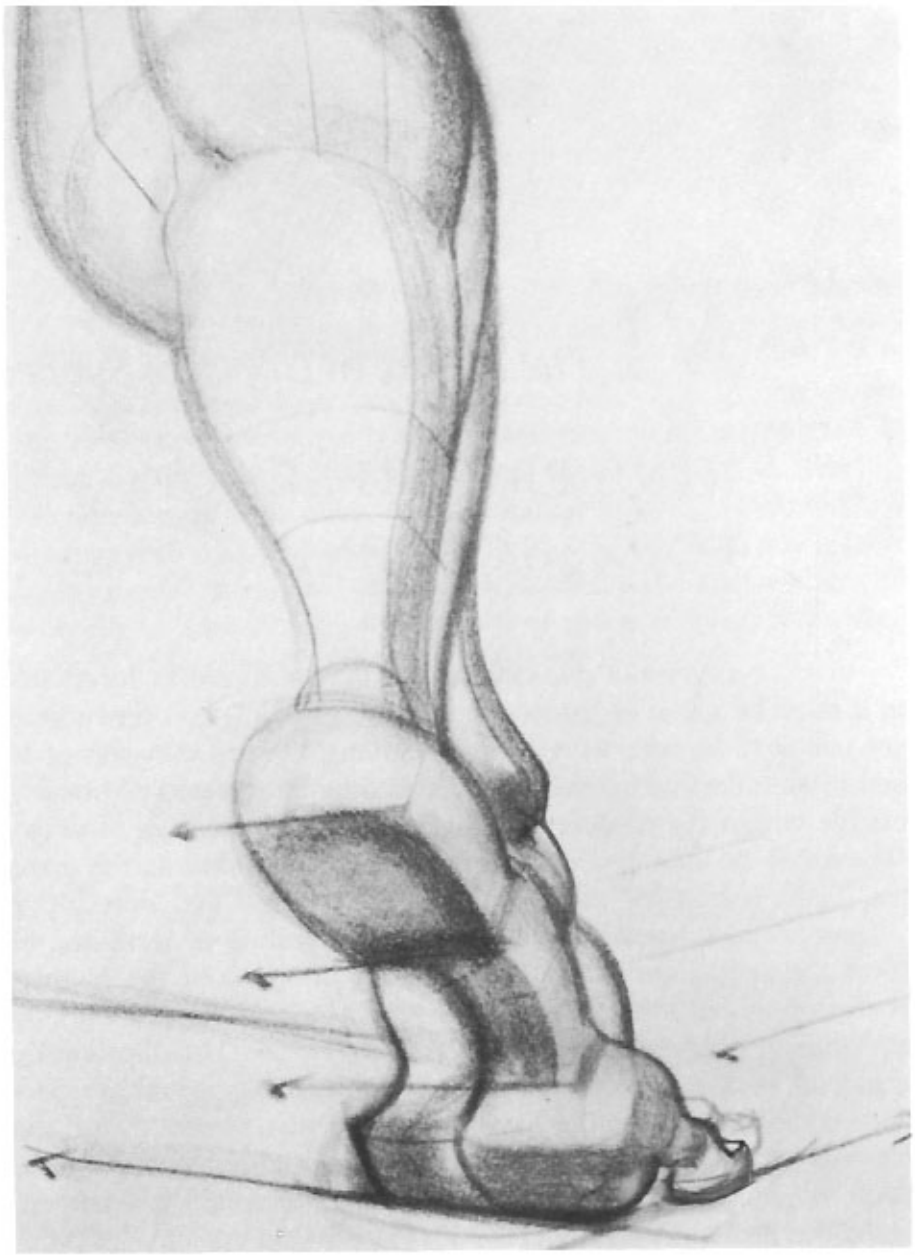


(d) To define the bottom surface easily, lay in a simple *footprint* first. Refining and developing of forms will follow quickly.

(e) The heel bone has a broad knob above it. This is the bursa and creates the dual form of the heel contour.

(f) The small toes of the foot have a different rhythm movement from the great toe. The big toe tends to swing up in an upthrust movement, while the smaller toes tend to press and grip the ground surface. Note the middle sections of the small toes. The dropped, almost vertical plane here contrasts sharply with the upward movement of the big toe.

(g) The foot is much like a hand; it is modified in order to give support to the body, as the hand is modified to act as a tool. The basic forms, however, are quite similar, and the identities of one should help the understanding of the other.





The upward thrust of the big toe, and the dropped middle sections of the small toes.

CHAPTER VI *The Figure in Depth of Space:*

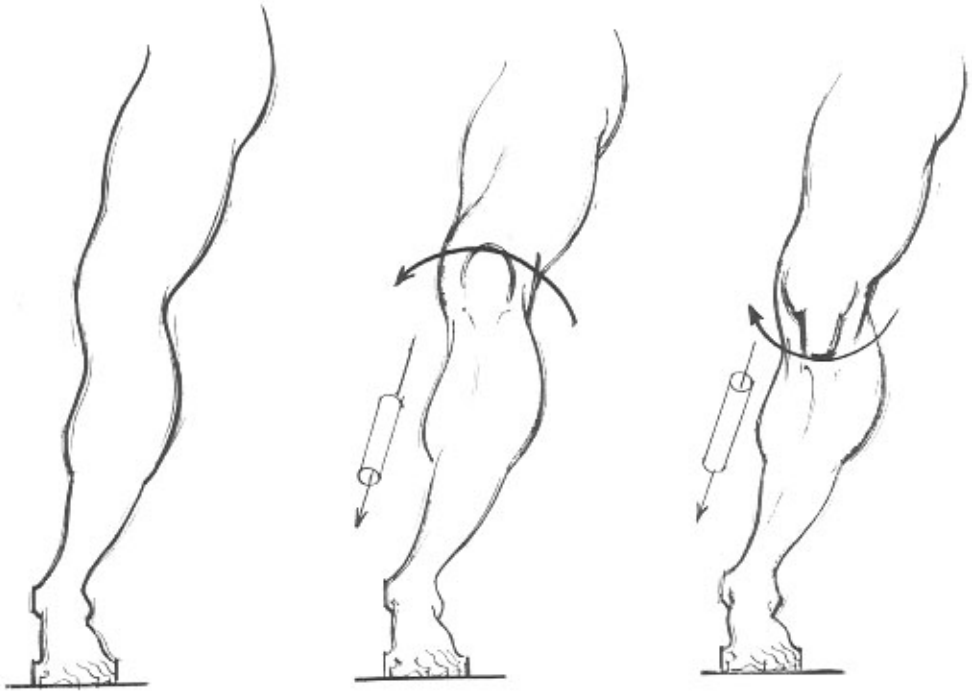
NINE PRINCIPLES OF FORESHORTENING

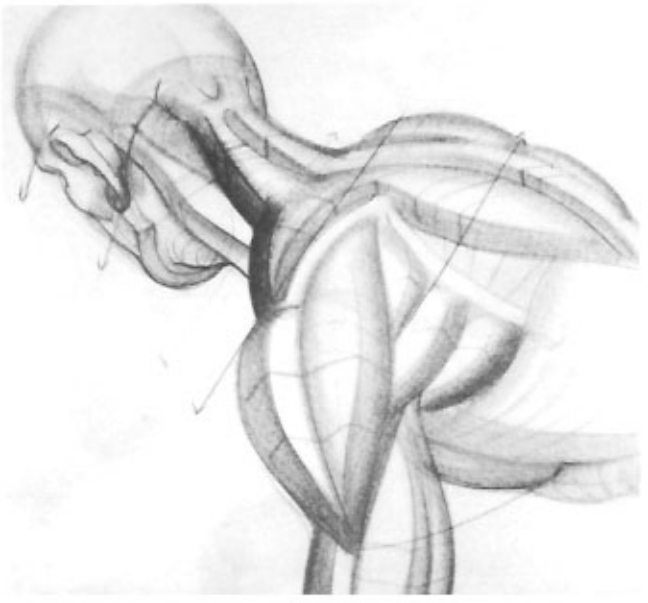
IN THESE OBSERVATIONS on the figure in foreshortening, it must be noted at the outset that the principles set down here are not meant to be seen as rigid formulations, nor are they meant to be used in an inflexible manner. They are to be interpreted as broadly as possible within the context of a given style or convention of drawing. They may be enlarged upon, modified, or discarded as the artist desires. Their reason for inclusion here is analytical and descriptive only. They are aids toward developing understanding of form and to reinforce the artist's command of the depth of space in the picture.

Artists throughout history have sought ways to make the flat working surface intrude and extrude, advance and recede. The illusionistic principles of light and shade to produce form, linear visual perspective, and figure foreshortening have been great discoveries toward the solutions of depth on two-dimensional surface. The human apparatus of vision, the eye, cannot see depth. The third dimension is a perception factor of experience judgment, developed through physical contact and body movement in the objective world of reality. If we could see depth as a three-dimensional reality, it would be possible to see above, under, side and back of an object *simultaneously*, as a hand experiences depth when it holds a ball in its grasp. If the eye could do this, no photograph, ordinary or stereoscopic, no drawing however well modeled, could make us believe the existence of flat surface form — as the hand does not believe it when it reaches out to touch photographic form. Thus, in the drawing of the figure, the artist who desires a translation of a depth idea, whether he leans to the traditional or modern, from Da Vinci to Picasso, should equip himself with tried and fundamental disciplines of depth illusion before he seeks to exaggerate, distort, or invent new perceptions of the real. The nine principles are offered in this light; to enhance clarity of observations in artistic perception of depth toward the valid judgments of form.

1. *The Principle of Overlapping Shapes to Achieve Recession and Advancement of Form*

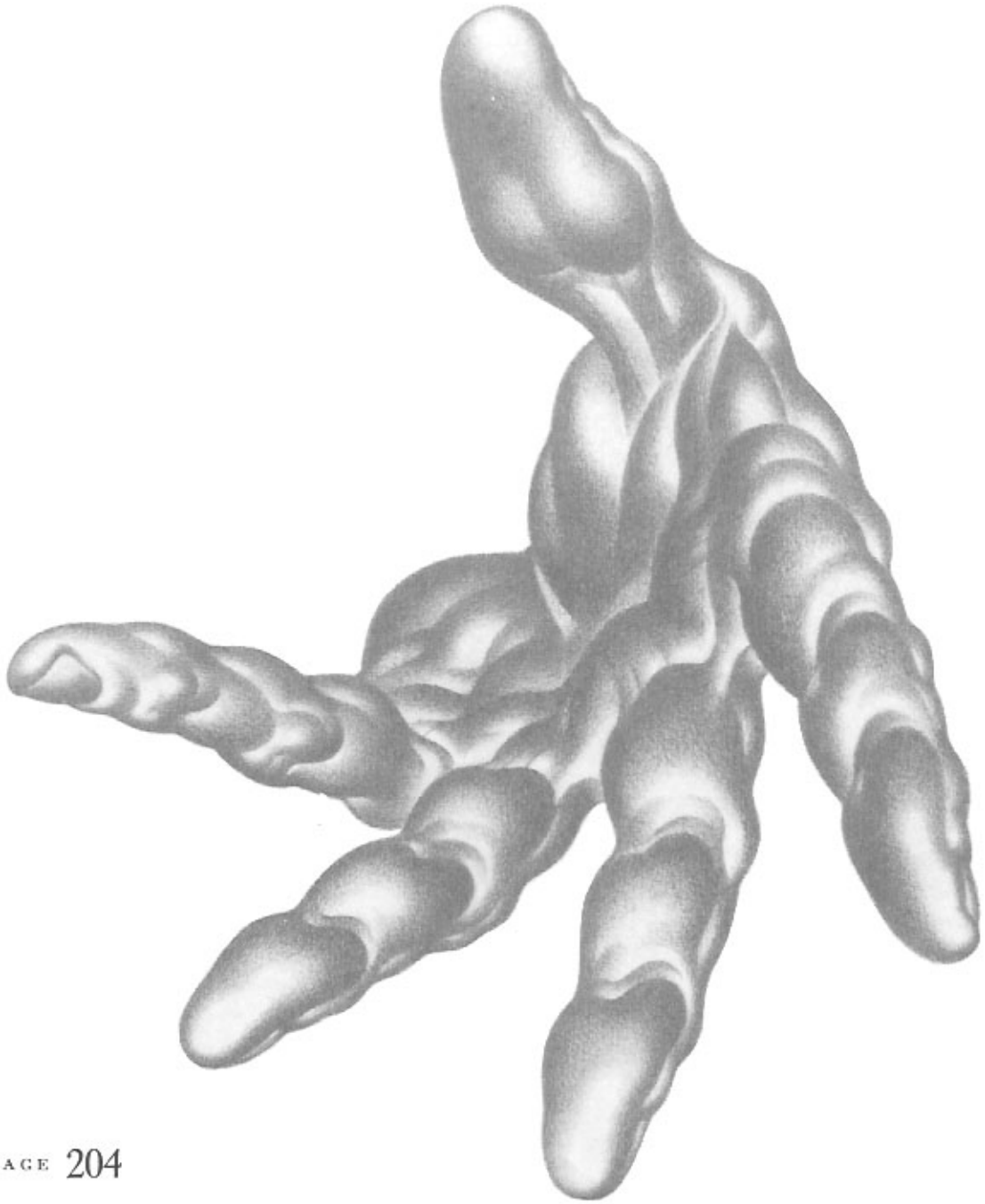
Forms will appear to advance or recede regardless of size or shape if the contour of one form is clearly intercepted or overlapped by another. Experience and common sense understanding of near and far relationship will produce the illusion of spatial position. However, observe that when contours of forms are tangent, i.e., when their outlines are not overlapped but merely continue the contour line, the result will be a confusion of the depth of space. Neither form, the front or rear, will appear to advance or recede.



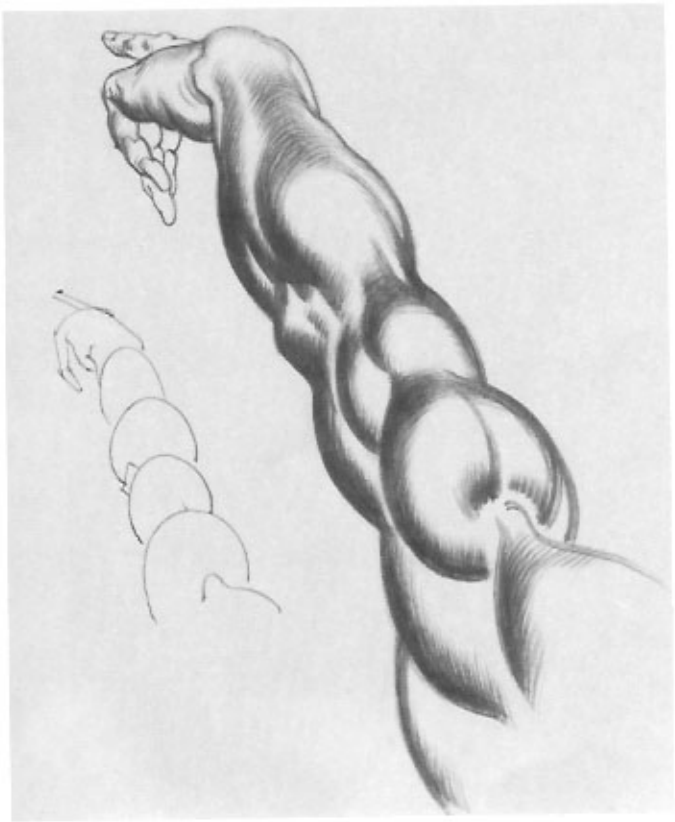


2. *The Principle of Cylindrical Forms which Become Circular in Foreshortening*

In the foreshortening of body forms which are generally cylindrical, the *width* of form will remain *constant* as the *length shortens* in depth. Therefore, as a leg or arm is seen on end or in deep space, the effect produced is a circular shape around the width of form as the cylinder length disappears.





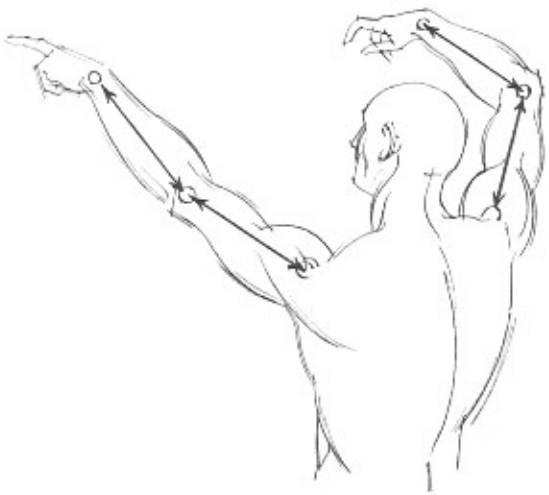


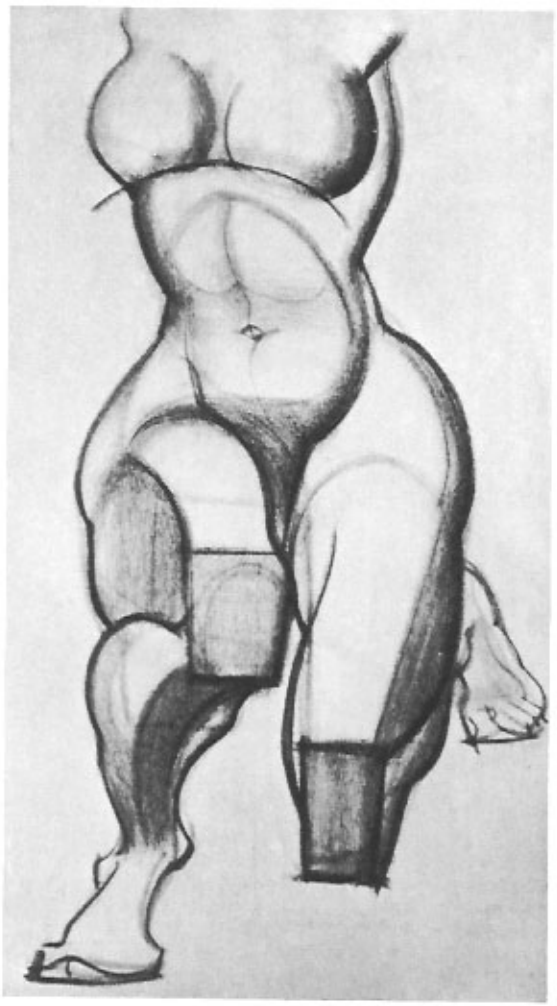


3. *The Principle of Positioning the Joints at Determined Lengths before Filling in the Forms Between*

In order to achieve extreme views of depth in body forms such as legs and arms moving directly in or out of the flat surface, the positions of the joints – hip, knee, ankle or shoulder, elbow, wrist – should be set down *first* at the required lengths. The forms may then be filled in between without distorting the view or stretching out the form beyond its normal appearance in the drawing.







4. *The Principle of Sharp Compression of Tapered Forms to Achieve Deep Foreshortening*

When forms are seen on end in deep space, the change in *contour* from one form to another will be sudden and abrupt. The effect produced will be a ballooning out of large form and quick tapering or wedging toward small form. The outline, moving with a sharp compression of form over the shortened length, will produce the illusion of great depth.







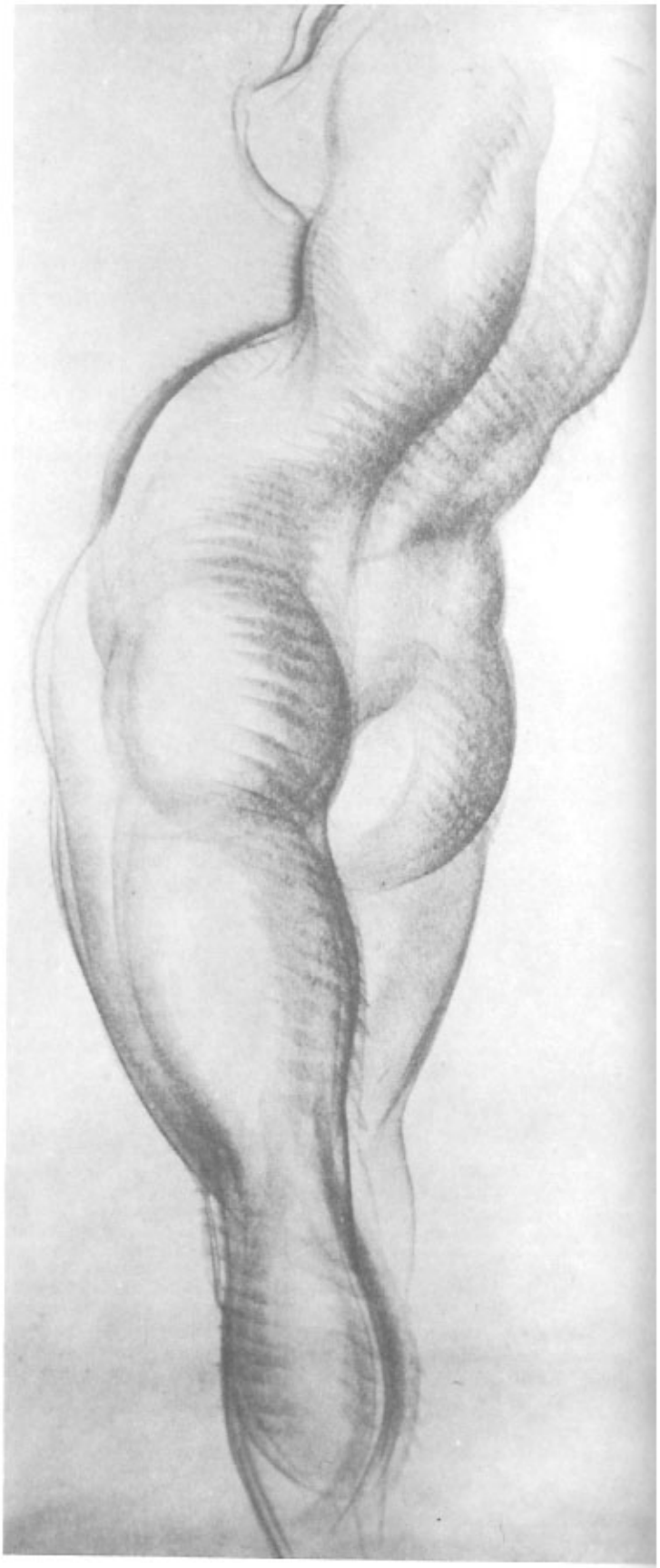


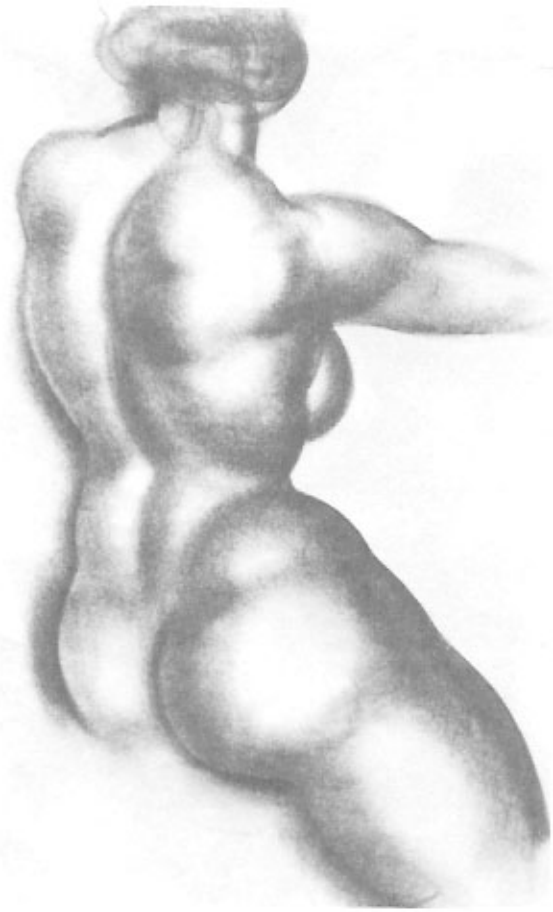
5. *The Principle of Using Arbitrary Values on Receding Planes*

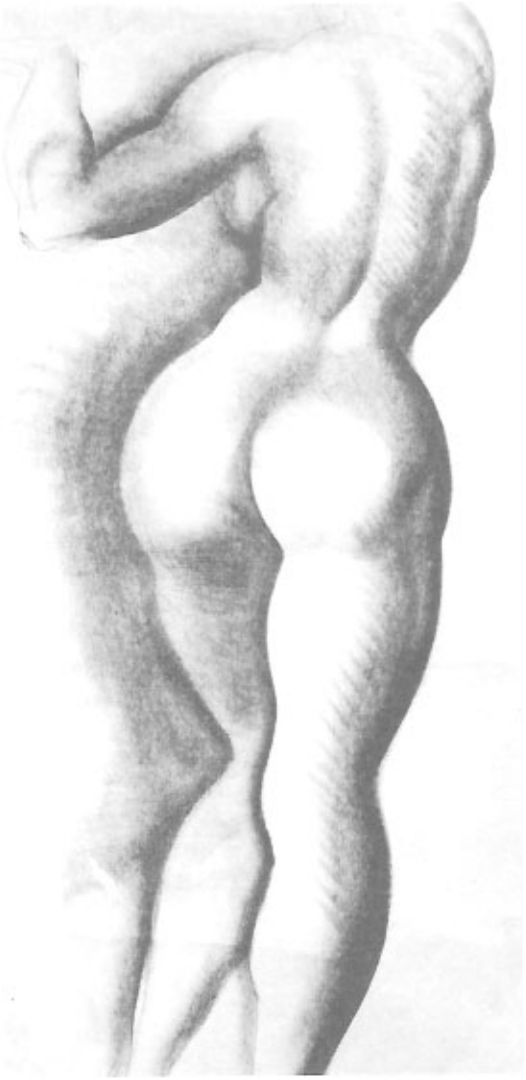
Forms which are *shaded* tend to produce a recession in depth of plane. When forms move away from the eye, shade or value on the receding area will heighten the effect of depth. On rounded surfaces, barreling or turning the stroke enhances the ability to project spherical compression of tapered forms.









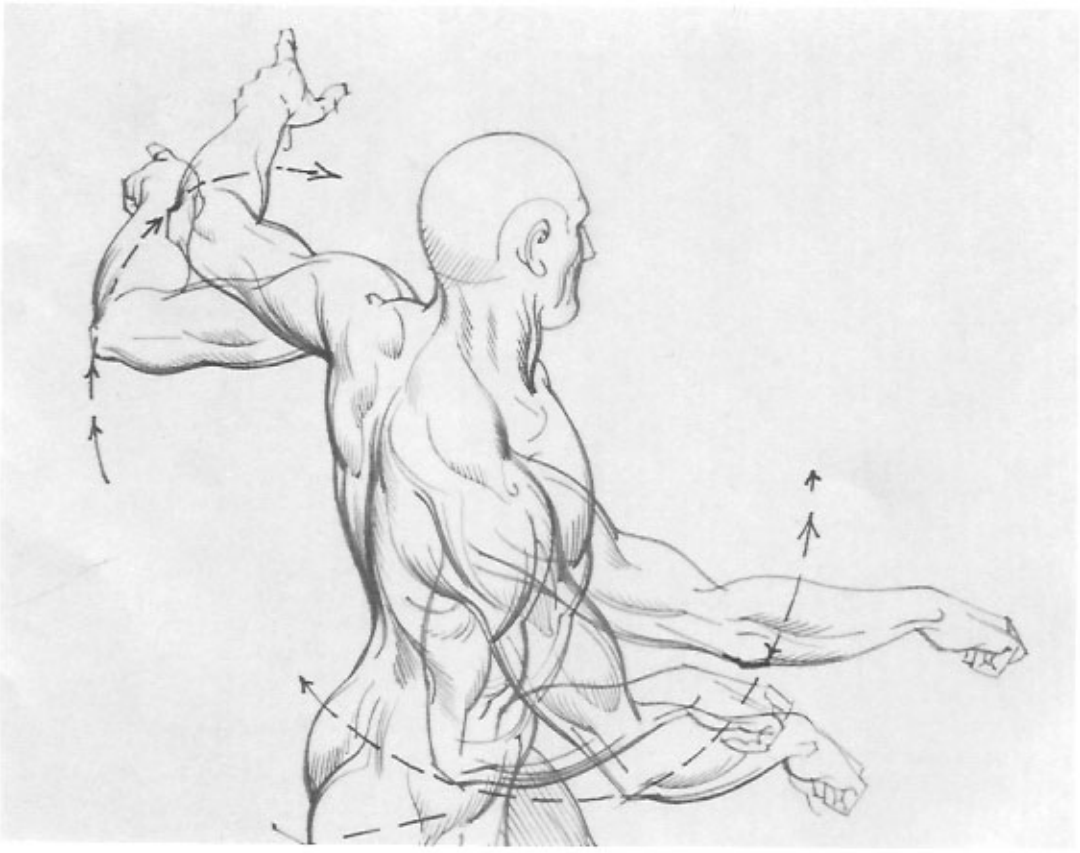






6. *The Principle of Using Perspective Ellipses in Foreshortening with a Joint as a Pivot*

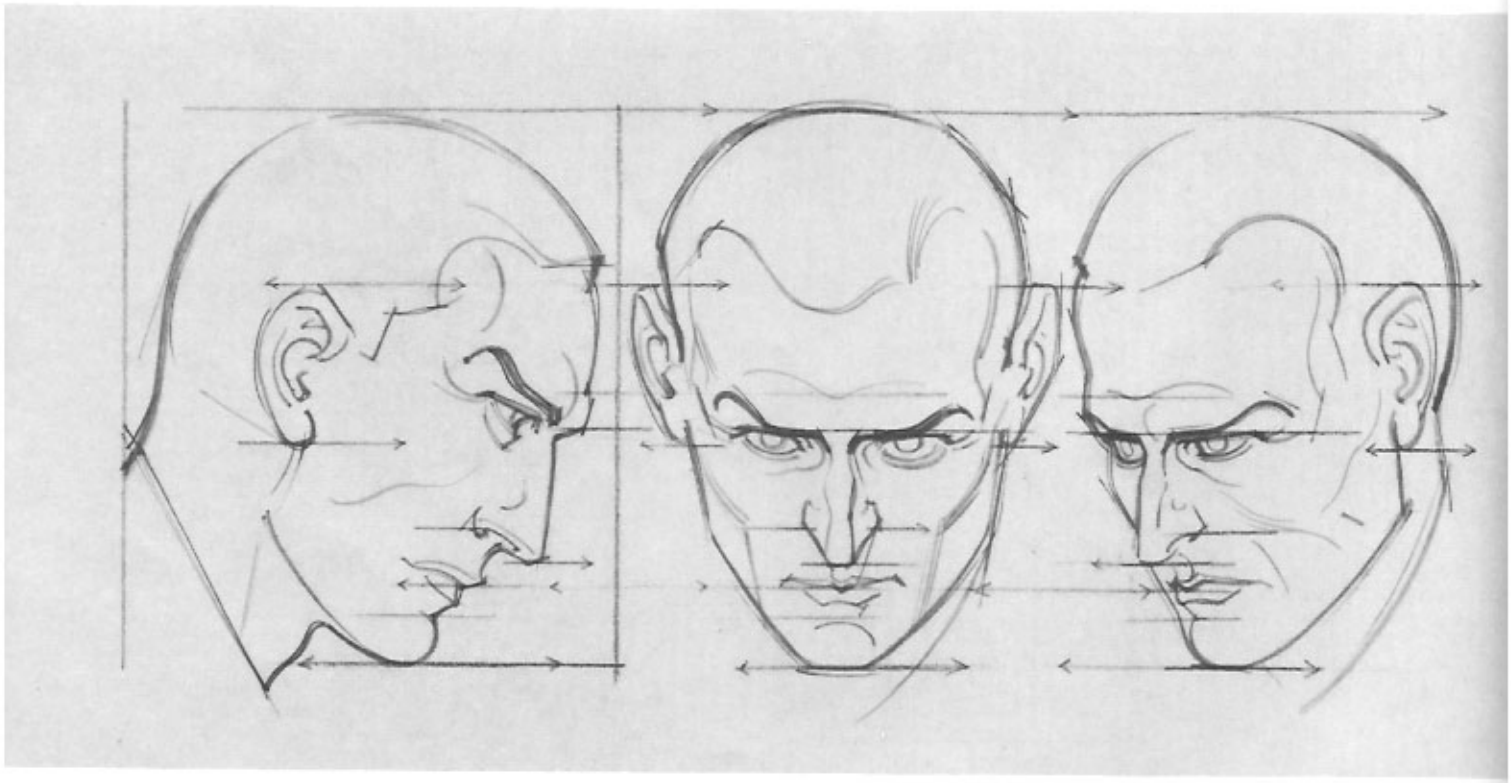
In order to maintain a proportionate length of a member, whatever its position in depth, a perspective circle or ellipse may be set up using the joint as a pivot or center of movement. Thus, in an arm, however the ellipse is seen from a viewing position, the measurements may be taken from shoulder or pivot, to the midway point, the elbow, and thence to the outer rim of the circle or hand position. In this sense, the arm length is a *radius of a circle*, however the circle may appear to be seen in a depth of space. The arm length, when placed at any position of a radius in the perspective circle, i.e., the length from shoulder to hand, will achieve a variety of positions. The series as a whole will produce a windmilling effect. This principle may be applied to a leg, with limited results, however.

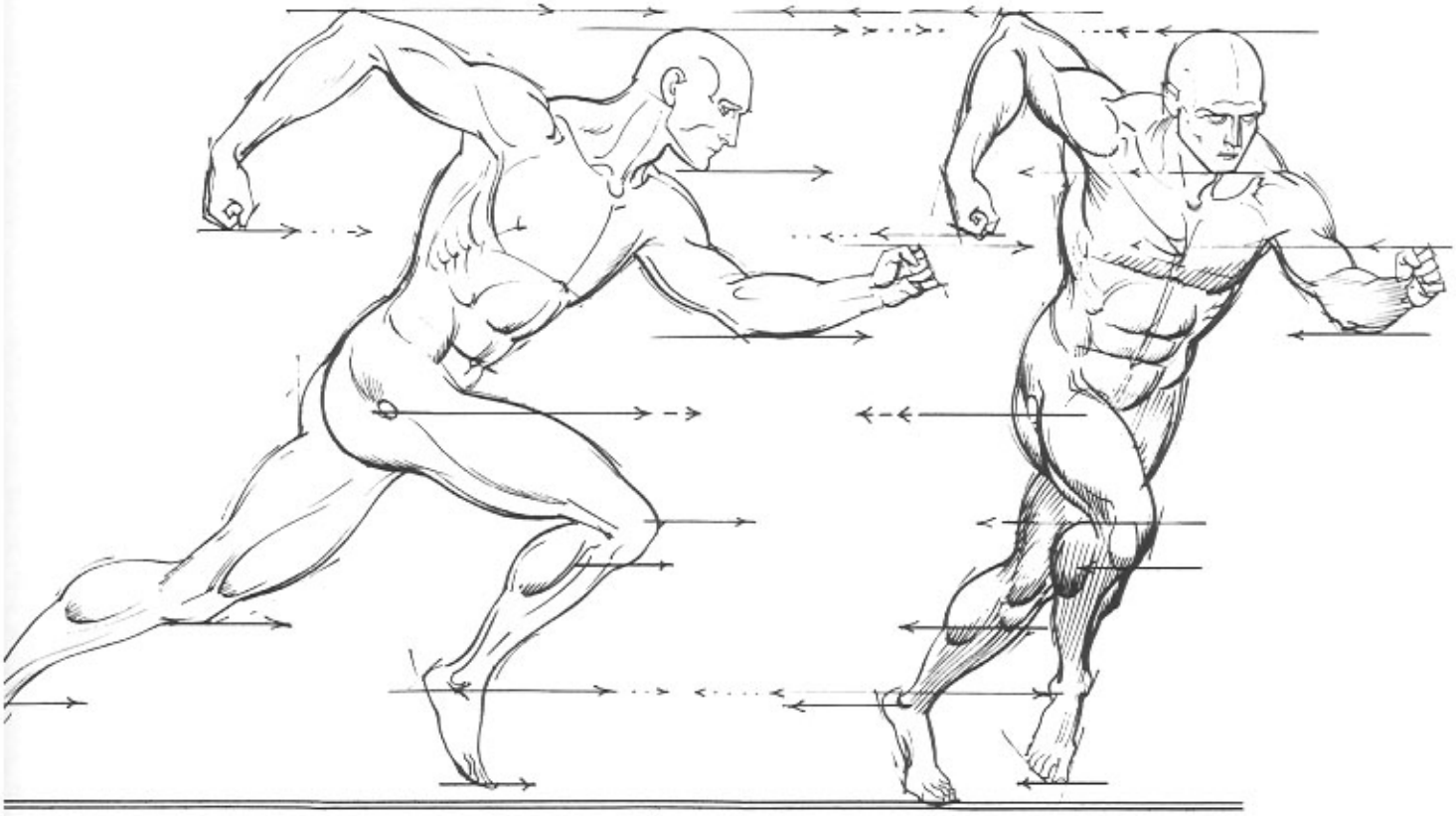




7. *The Principle of Projecting the Side View Figure to Achieve the Foreshortened Figure*

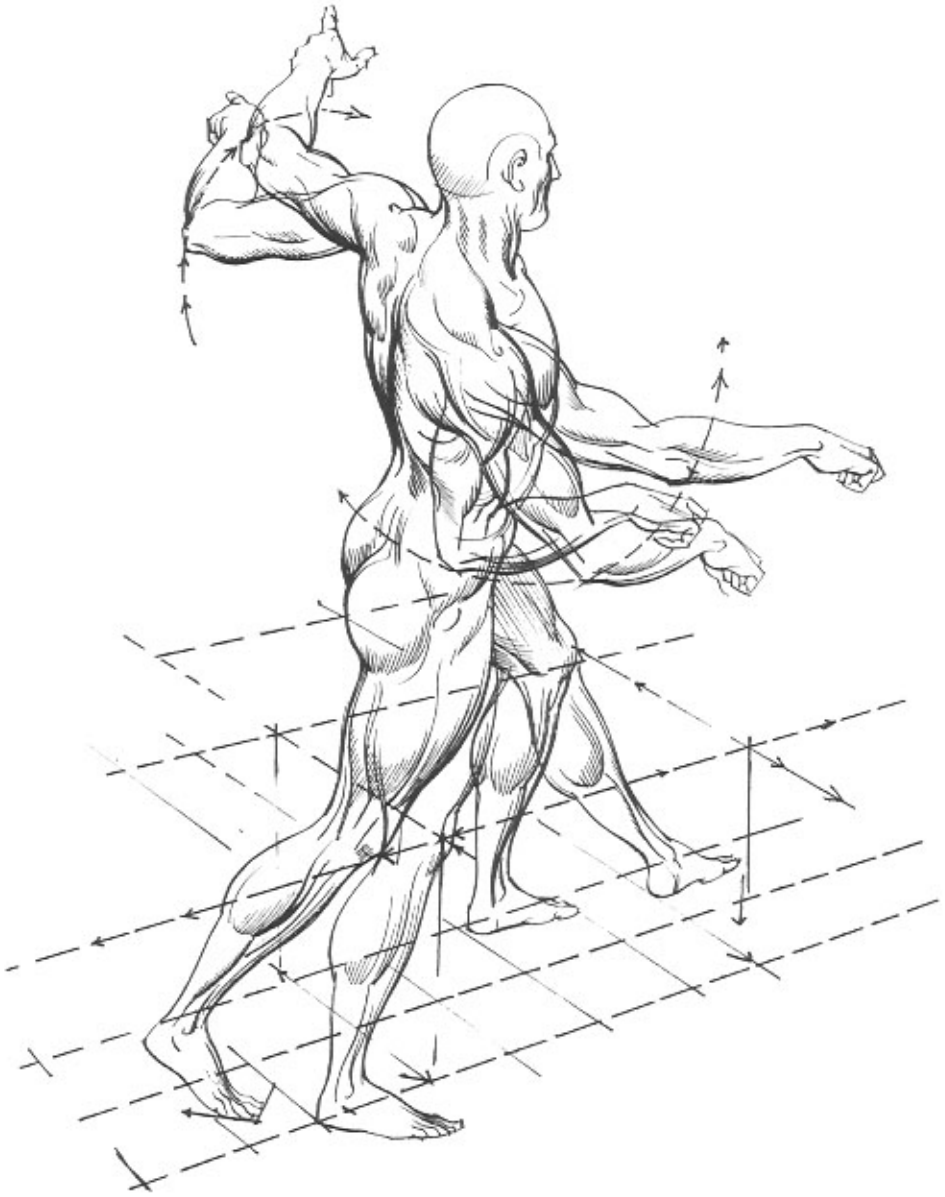
When the problem of visualizing the figure in deep space cannot be resolved, *a side view*, or easily understood profile of head or body, should be drawn in first. Tipping the figure forward or backward will produce a view from *above* or *below* respectively. Once the side view key drawing has been developed, projection lines drawn horizontally out to a drawing alongside the first will give the key positions of important parts of the body in *exactly* the same positions in the depth of space. Filling in form details afterward will present no problem once the proportionate positions are found.

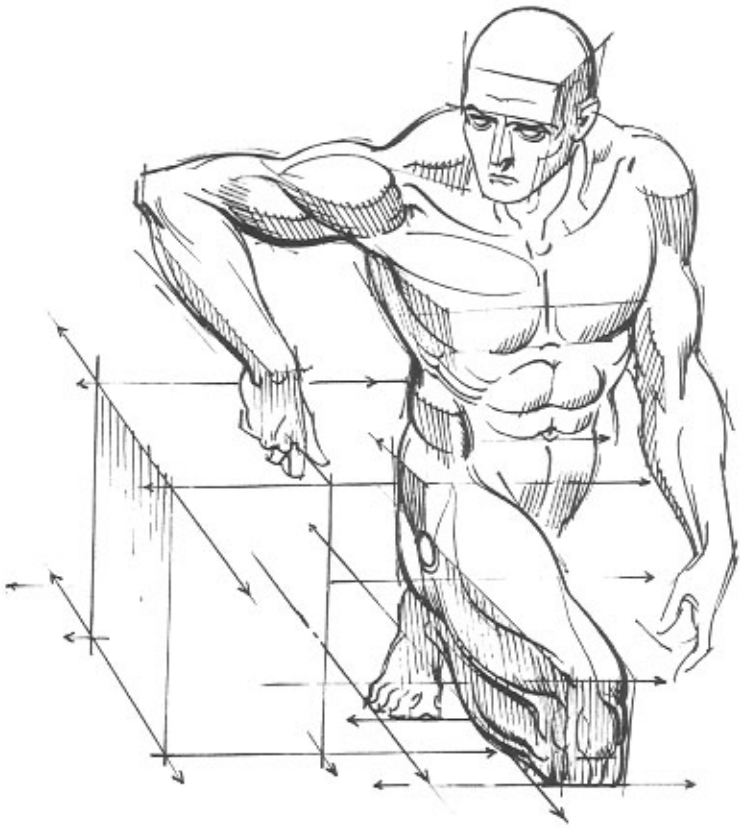




8. *The Principle of Perspective Tracking to Hold Correct Proportions in Deep Views of the Figure*

When the figure has been sketched in as a visual comprehensive, body forms may then be blocked in simple surfaces using a system of parallel perspective lines to hold the positions of planes correctly. If the figure is seen from a height, standing or moving, the placement of feet as they walk or arms as they move may be related to the ground plane without difficulty when the perspective system is applied to track the members seen in depth. An entire ground plane with objects may be added from the original perspective of the figure. Thus, the figure drawn in first will lend its perspective to an entire pictorial development in correct relationship throughout.

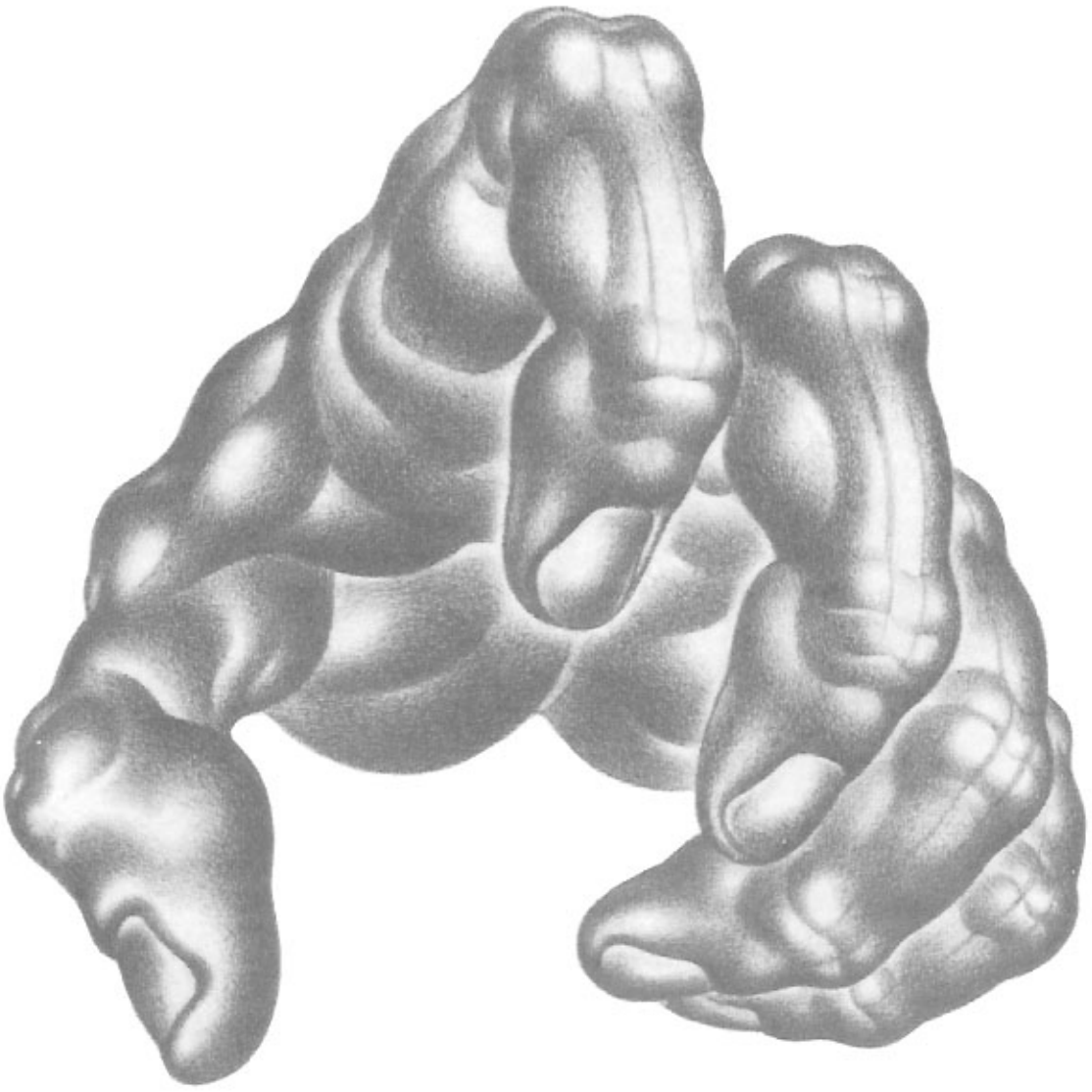


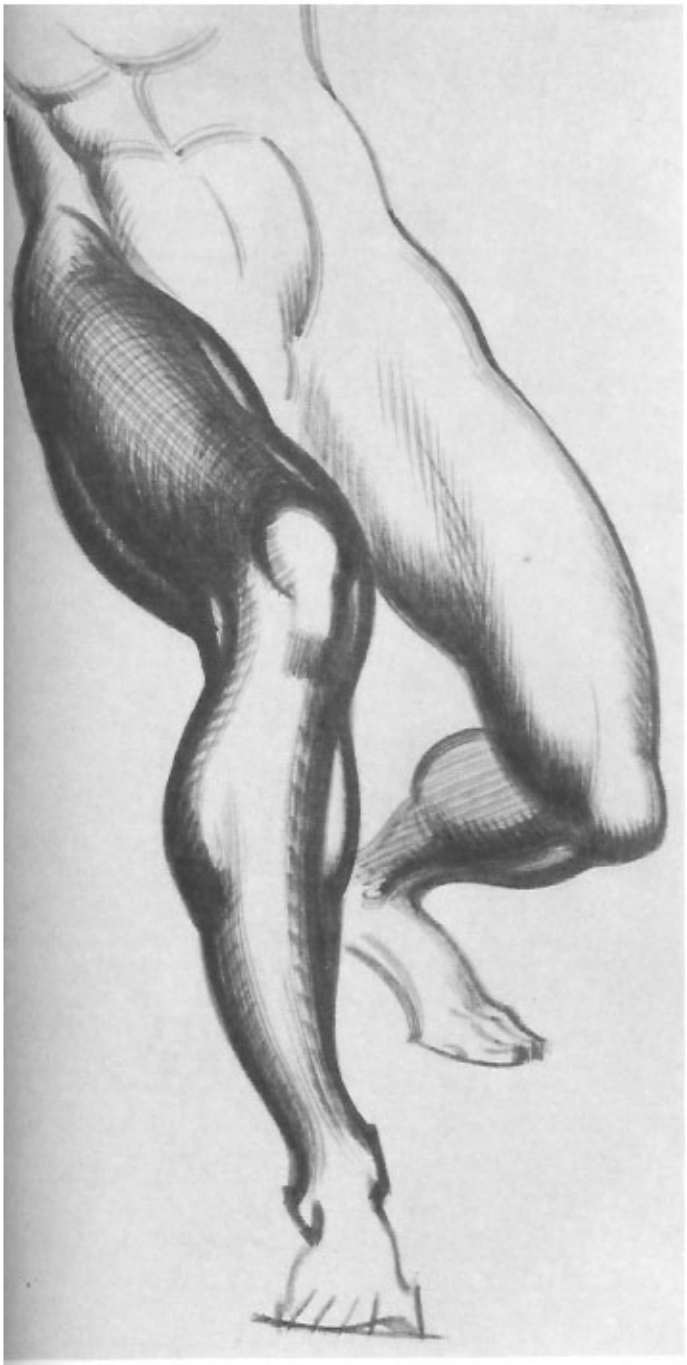




9. *The Principle of Interlacing the Joint to the Advancing Member*

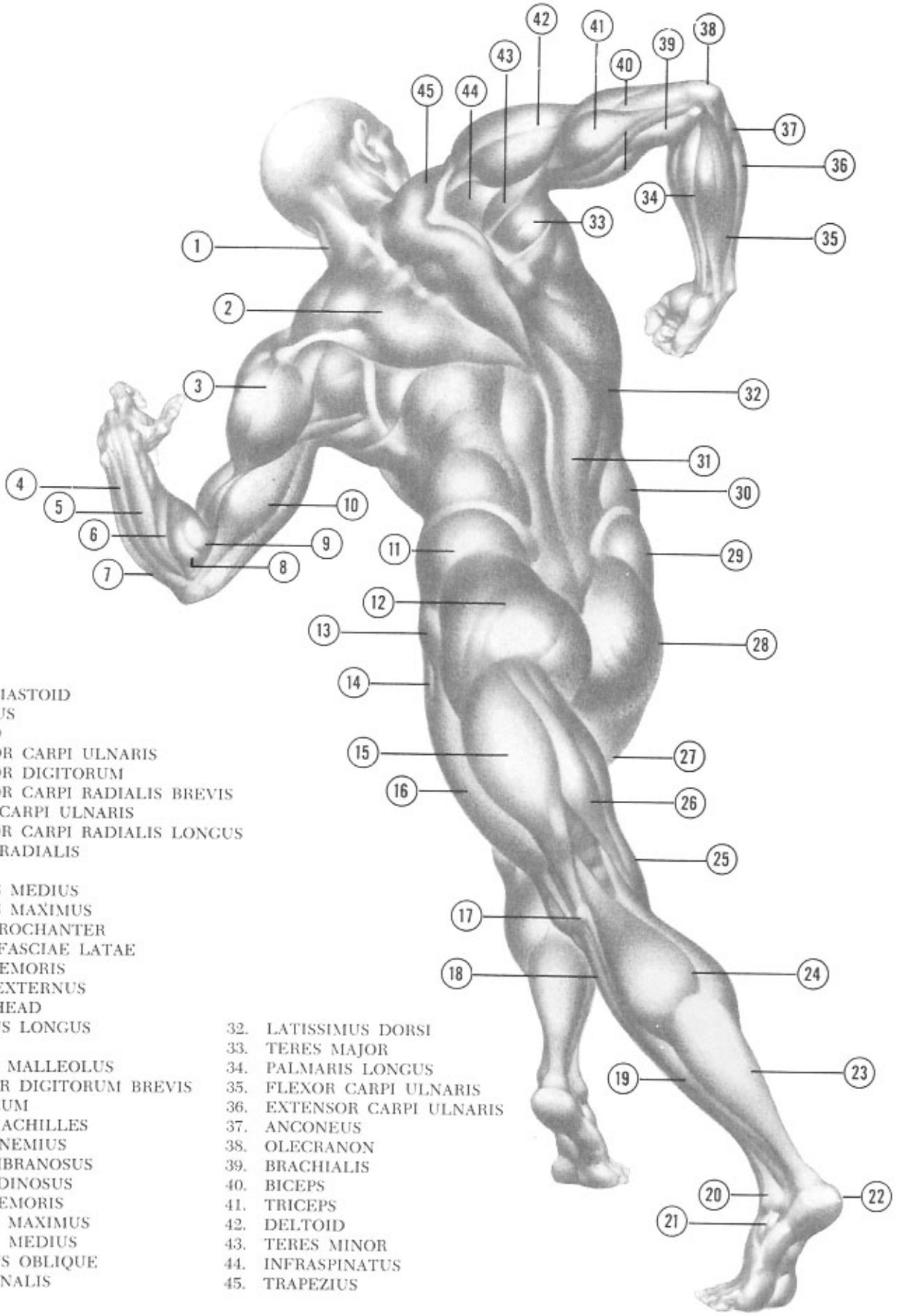
When parts of the body bend (fingers, arms, legs) two forms are presented moving in opposite directions — the *advancing* member and the *receding* member. The joint between, an elbow, knee or knuckle, must be placed or drawn interlaced upon the *advancing* member. Violation of the premise usually results in a complete confusion of movement, and the direction of the member will appear to move in reverse.



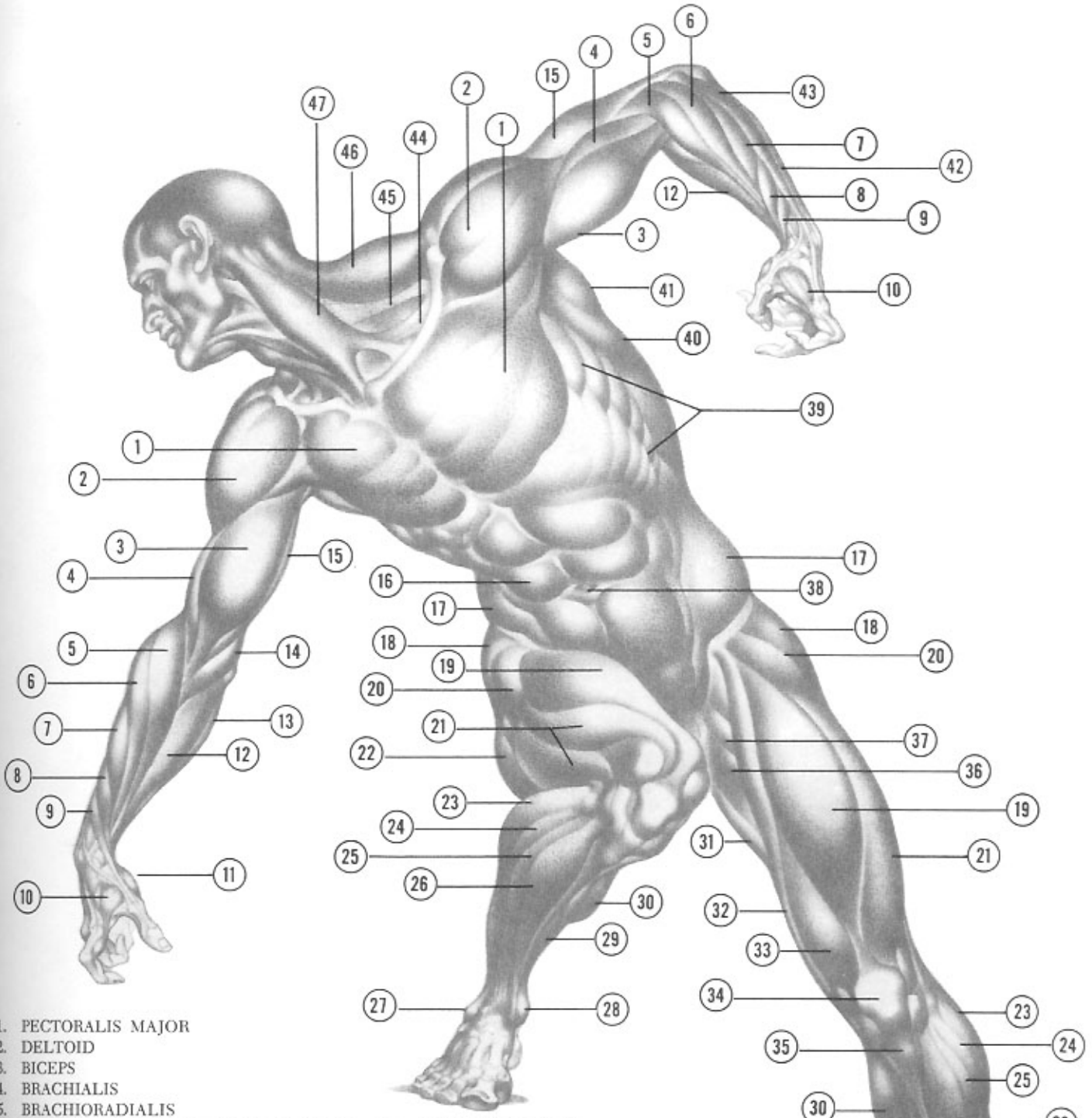






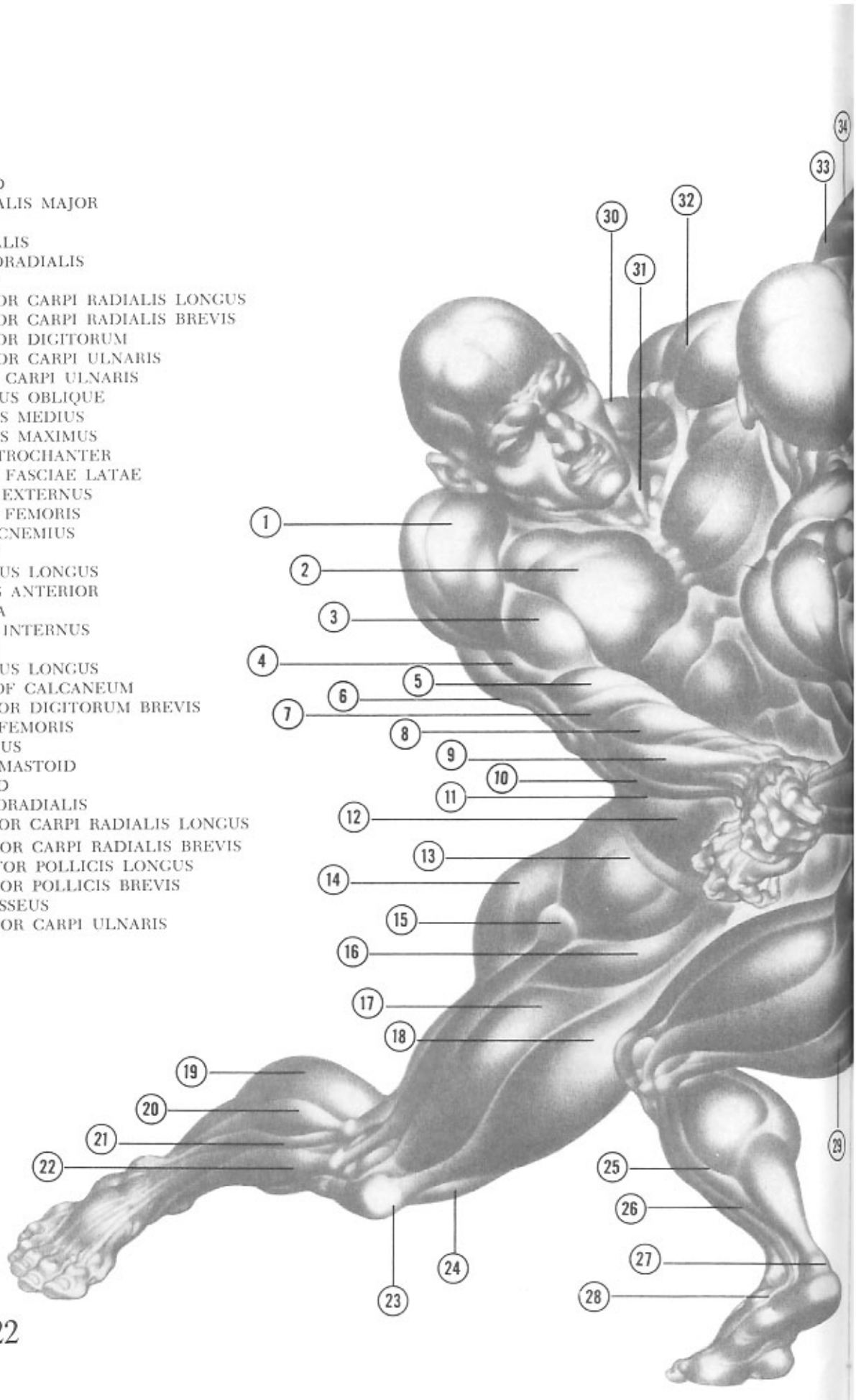


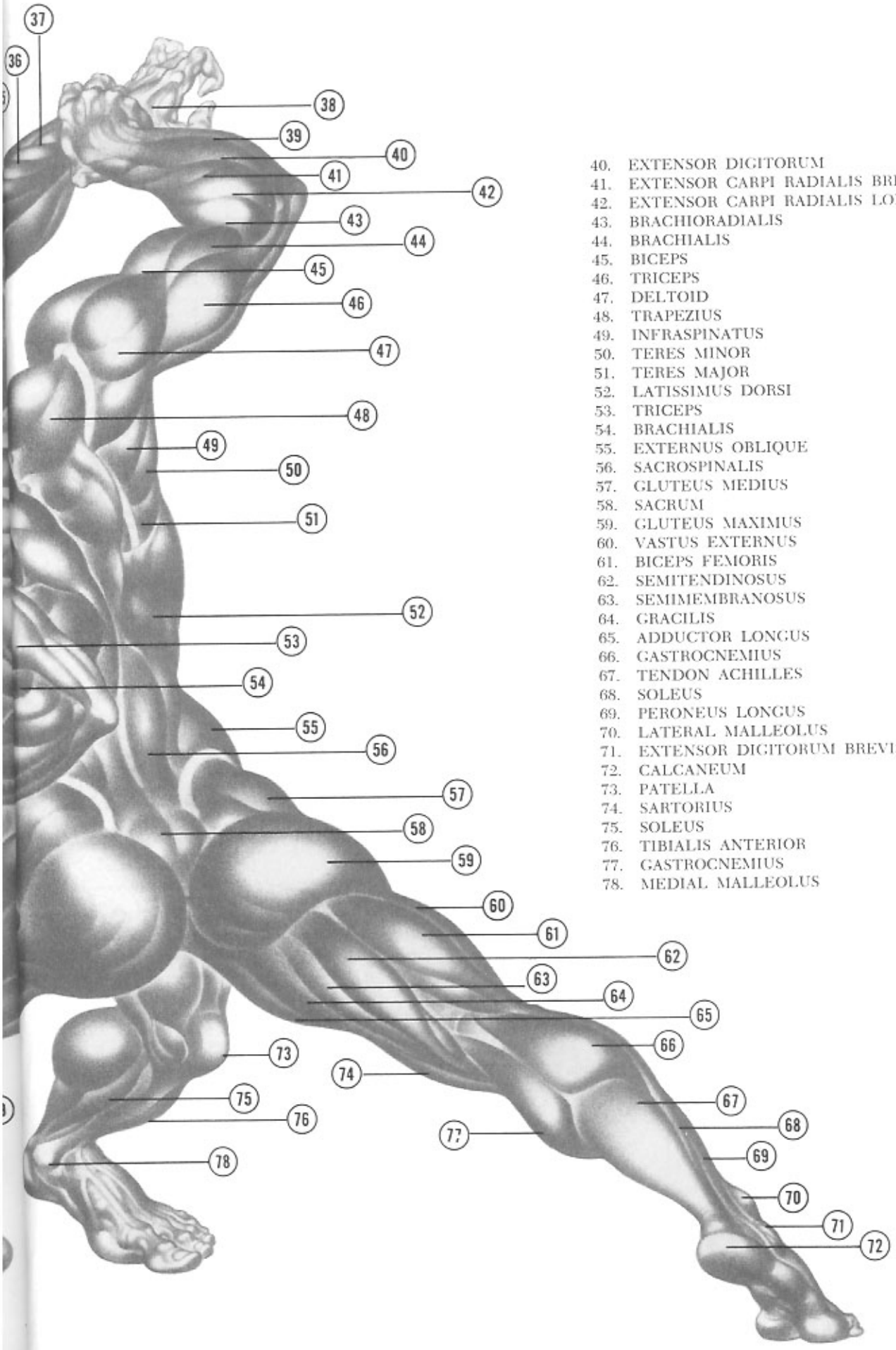
1. STERNOMASTOID
2. TRAPEZIUS
3. DELTOID
4. EXTENSOR CARPI ULNARIS
5. EXTENSOR DIGITORUM
6. EXTENSOR CARPI RADIALIS BREVIS
7. FLEXOR CARPI ULNARIS
8. EXTENSOR CARPI RADIALIS LONGUS
9. BRACHIORADIALIS
10. TRICEPS
11. GLUTEUS MEDIUS
12. GLUTEUS MAXIMUS
13. GREAT TROCHANTER
14. TENSOR FASCIAE LATAE
15. BICEPS FEMORIS
16. VASTUS EXTERNUS
17. FIBULA HEAD
18. PERONEUS LONGUS
19. SOLEUS
20. LATERAL MALLEOLUS
21. EXTENSOR DIGITORUM BREVIS
22. CALCANEUM
23. TENDON ACHILLES
24. GASTROCNEMIUS
25. SEMIMEMBRANOSUS
26. SEMITENDINOSUS
27. BICEPS FEMORIS
28. GLUTEUS MAXIMUS
29. GLUTEUS MEDIUS
30. EXTERNUS OBLIQUE
31. SACROSPINALIS
32. LATISSIMUS DORSI
33. TERES MAJOR
34. PALMARIS LONGUS
35. FLEXOR CARPI ULNARIS
36. EXTENSOR CARPI ULNARIS
37. ANCONEUS
38. OLECRANON
39. BRACHIALIS
40. BICEPS
41. TRICEPS
42. DELTOID
43. TERES MINOR
44. INFRASPINATUS
45. TRAPEZIUS



1. PECTORALIS MAJOR
2. DELTOID
3. BICEPS
4. BRACHIALIS
5. BRACHIORADIALIS
6. EXTENSOR CARPI RADIALIS LONGUS
7. EXTENSOR CARPI RADIALIS BREVIS
8. ABDUCTOR POLLICIS LONGUS
9. EXTENSOR POLLICIS BREVIS
10. INTEROSSEUS
11. ABDUCTOR POLLICIS BREVIS
12. FLEXOR CARPI RADIALIS
13. PALMARIS LONGUS
14. PRONATOR TERES
15. TRICEPS
16. RECTUS ABDOMINIS
17. EXTERNUS OBLIQUE
18. GLUTEUS MEDIUS
19. RECTUS FEMORIS
20. TENSOR FASCIAE LATAE
21. VASTUS EXTERNUS
22. GLUTEUS MAXIMUS
23. GASTROCNEMIUS
24. SOLEUS
25. PERONEUS LONGUS
26. TIBIALIS ANTERIOR
27. LATERAL MALLEOLUS
28. MEDIAL MALLEOLOUS
29. SOLEUS
30. GASTROCNEMIUS
31. GRACILIS
32. SARTORIUS
33. VASTUS INTERNUS
34. PATELLA
35. TIBIAL TUBEROSITY
36. ADDUCTOR LONGUS
37. PECTINEUS
38. UMBILICUS
39. SERRATUS ANTERIOR
40. LATISSIMUS DORSI
41. TERES MAJOR
42. EXTENSOR DIGITORUM
43. ANCONEUS
44. OMOHYOID
45. LEVATOR SCAPULAE
46. TRAPEZIUS
47. STERNOMASTOID

1. DELTOID
2. PECTORALIS MAJOR
3. BICEPS
4. BRACHIALIS
5. BRACHIORADIALIS
6. TRICEPS
7. EXTENSOR CARPI RADIALIS LONGUS
8. EXTENSOR CARPI RADIALIS BREVIS
9. EXTENSOR DIGITORUM
10. EXTENSOR CARPI ULNARIS
11. FLEXOR CARPI ULNARIS
12. EXTERNUS OBLIQUE
13. GLUTEUS MEDIUS
14. GLUTEUS MAXIMUS
15. GREAT TROCHANTER
16. TENSOR FASCIAE LATAE
17. VASTUS EXTERNUS
18. RECTUS FEMORIS
19. GASTROCNEMIUS
20. SOLEUS
21. PERONEUS LONGUS
22. TIBIALIS ANTERIOR
23. PATELLA
24. VASTUS INTERNUS
25. SOLEUS
26. PERONEUS LONGUS
27. BURSA OF CALCANEUM
28. EXTENSOR DIGITORUM BREVIS
29. BICEPS FEMORIS
30. TRAPEZIUS
31. STERNOMASTOID
32. DELTOID
33. BRACHIORADIALIS
34. EXTENSOR CARPI RADIALIS LONGUS
35. EXTENSOR CARPI RADIALIS BREVIS
36. ABDUCTOR POLLICIS LONGUS
37. EXTENSOR POLLICIS BREVIS
38. INTEROSSEUS
39. EXTENSOR CARPI ULNARIS





40. EXTENSOR DIGITORUM
41. EXTENSOR CARPI RADIALIS BREVIS
42. EXTENSOR CARPI RADIALIS LONGUS
43. BRACHIORADIALIS
44. BRACHIALIS
45. BICEPS
46. TRICEPS
47. DELTOID
48. TRAPEZIUS
49. INFRASPINATUS
50. TERES MINOR
51. TERES MAJOR
52. LATISSIMUS DORSI
53. TRICEPS
54. BRACHIALIS
55. EXTERNUS OBLIQUE
56. SACROSPINALIS
57. GLUTEUS MEDIUS
58. SACRUM
59. GLUTEUS MAXIMUS
60. VASTUS EXTERNUS
61. BICEPS FEMORIS
62. SEMITENDINOSUS
63. SEMIMEMBRANOSUS
64. GRACILIS
65. ADDUCTOR LONGUS
66. GASTROCNEMIUS
67. TENDON ACHILLES
68. SOLEUS
69. PERONEUS LONGUS
70. LATERAL MALLEOLUS
71. EXTENSOR DIGITORUM BREVIS
72. CALCANEUM
73. PATELLA
74. SARTORIUS
75. SOLEUS
76. TIBIALIS ANTERIOR
77. GASTROCNEMIUS
78. MEDIAL MALLEOLUS

1. EXTENSOR CARPI ULNARIS
2. EXTENSOR POLLICIS BREVIS
3. ABDUCTOR POLLICIS LONGUS
4. EXTENSOR CARPI RADIALIS BREVIS
5. EXTENSOR DIGITORUM
6. DELTOID
7. BICEPS
8. EXTENSOR CARPI RADIALIS LONGUS
9. LATERAL FEMORAL CONDYLE
10. PATELLA
11. FIBULA HEAD
12. MEDIAL FEMORAL CONDYLE
13. TIBIAL TUBEROSITY
14. SARTORIUS
15. GASTROCNEMIUS
16. ADDUCTOR LONGUS
17. GRACILIS
18. RECTUS FEMORIS
19. VASTUS EXTERNUS
20. VASTUS INTERNUS
21. GASTROCNEMIUS
22. LATERAL FEMORAL CONDYLE
23. MEDIAL FEMORAL CONDYLE
24. PATELLA
25. LATERAL TIBIAL CONDYLE
26. MEDIAL TIBIAL CONDYLE
27. TRAPEZIUS
28. OMOHYOID
29. DELTOID
30. TRICEPS – LONG HEAD
31. TRICEPS – LATERAL HEAD
32. BICEPS
33. BRACHIALIS
34. OLECRANON
35. BRACHIORADIALIS
36. EXTENSOR CARPI RADIALIS LONGUS
37. EXTENSOR CARPI RADIALIS BREVIS
38. EXTENSOR DIGITORUM
39. FLEXOR CARPI ULNARIS
40. TERES MAJOR
41. STERNOMASTOID
42. PECTORALIS MAJOR
43. LATISSIMUS DORSI
44. SERRATUS ANTERIOR
45. FLEXOR CARPI ULNARIS
46. ANCONEUS
47. RECTUS ABDOMINIS
48. OLECRANON
49. RECTUS FEMORIS
50. EXTERNUS OBLIQUE
51. VASTUS EXTERNUS
52. TENSOR FASCIAE LATAE
53. GASTROCNEMIUS
54. GLUTEUS MEDIUS
55. SOLEUS
56. TIBIALIS ANTERIOR
57. GREAT TROCHANTER
58. GLUTEUS MAXIMUS
59. SOLEUS
60. EXTENSOR DIGITORUM LONGUS
61. MEDIAL MALLEOLUS
62. LATERAL MALLEOLUS
63. EXTENSOR DIGITORUM BREVIS

